DEMONSTRATIONS

OF

A N A T O M Y.

London:
Printed by Spottiswoode & Co.,
New-street-Square.

DEMONSTRATIONS

OF

ANATOMY;

BEING A

GUIDE TO THE KNOWLEDGE OF THE HUMAN BODY

BY

DISSECTION.

BY

GEORGE VINER ELLIS,

PROFESSOR OF ANATOMY IN UNIVERSITY COLLEGE, LONDON.

FOURTH EDITION, REVISED.

LONDON:

WALTON AND MABERLY, UPPER GOWER STREET;

AND IVY LANE, PATERNOSTER ROW.

1856.

PREFACE.

THE plan of this work has been retained without alteration in the present edition. It was devised for the purpose of teaching Anatomy by the dissection of the several parts of the Human Body in successive layers or stages; and the mode of proceeding observed in its execution has been thus explained in a former Preface. In the examination of a part or region, the attention of the student is directed first to its limits, to the superficial prominences of bone and muscle, and to the hollows that point out the situation of the subjacent vessels. The different strata interposed between the surface and the bones are next examined in succession, with reference particularly to the natural position of the several objects and their connections with each other, so that they may be observed in much the same order as they would be met with in an operation of surgery. The anatomical description of the whole is likewise arranged in conformity with the mode of dissection, and each bloodvessel, nerve, or other structure, is described only to such an extent as it may be laid bare in the region under examination.

In this edition of my "Demonstrations of Anatomy," I have endeavoured to make the work more complete by the correction of inaccuracies, and to render it more efficient, as a guide to dissection, by the introduction of such alterations as greater experience in teaching has shown to be desirable. The instructions for conducting

the progressive stages of a dissection have also undergone careful revision, and are better adapted to aid the student in following the more difficult directions, and to assist him in distinguishing objects which become visible on the removal of the superficial parts.

Little alteration can be made in each forthcoming edition of a work on Practical Anatomy. The chief additions to this volume are included in the account of the structure of the urinary and generative organs, and the organs of the senses.

G. V. E.

University College, London.
Nov. 1856.

CONTENTS.

CHAPTER I.

DISSECTION OF THE HEAD AND NECK.

CHAPTER II.

DISSECTION OF THE BRAIN.

CHAPTER III.

DISSECTION OF THE UPPER LIMB.

CHAPTER IV.

DISSECTION OF THE THORAX.

CHAPTER V.

DISSECTION OF THE BACK.

CHAPTER VI.

DISSECTION OF THE SPINAL CORD.

CHAPTER VII.

DISSECTION OF THE PERINÆUM.

CHAPTER VIII.

DISSECTION OF THE ABDOMEN.

DISSECTION OF THE PELVIS.

CHAPTER IX.

DISSECTION OF THE LOWER LIMB.

CHAPTER X.

DISSECTION OF THE EYE.

CHAPTER XI.

DISSECTION OF THE EAR.

DEMONSTRATIONS OF ANATOMY.

CHAPTER I.

DISSECTION OF THE HEAD AND NECK.

Section I.

EXTERNAL PARTS OF THE HEAD.

Directions. — In the dissection of the head and neck, the student should endeavour to learn the anatomy of the parts described in the first sixty pages before the first position of the body is changed; but should want of time necessitate an omission of some part, the examination of the facial nerve (p. 39.) can be best deferred till a subsequent stage. The orbit on one side, and the posterior triangular space on both sides of the neck, as well as the objects on the exterior and interior of the head, should be examined whilst the body lies on the back. Parts to be learnt before the body is turned.

Position. — During the examination of the superficial parts of the head, the body lies on the back, and the head, raised to a suitable height, is to be turned to the right side. On the left side the muscles are to be seen, and on the opposite half the vessels and nerves are to be displayed. Position of the body.

Muscles of the external Ear. — Three muscles attach the outer ear to the side of the head. Two are above it, one elevating, the other drawing it forwards; and the third, a retrahent muscle, is behind the ear. There are other special or intrinsic muscles of the cartilage of the ear, which will be afterwards described. Muscles of the ear.

Dissection of the upper muscles,

Dissection. — When the ear has been drawn down by hooks, the position of the two upper muscles will be indicated by a slight prominence between it and the head; and the muscular fibres will be laid bare by means of the two following incisions, made no deeper than the skin. One of these is to be carried upwards along the cutaneous ridge before mentioned and the side of the head, for about three inches; and the other is to be directed from before backwards close above the ear, for nearly the same distance, so that the two may join at a right angle in the middle of the last. On carefully raising the flaps of skin from below upwards, and removing a little subjacent tissue, the thin muscular fibres will come into view — the more anterior constituting the attrahens, and the posterior the attollens aurem muscle.

of posterior muscle.

On drawing forwards the ear, a ridge marks, in like manner, the situation of the posterior muscle. To remove the integuments, let the scalpel be drawn down, about an inch behind the ear, from the transverse cut above as far as to a level with the lobule of the ear, and then forwards below the lobule. After the piece of skin included by these cuts has been reflected towards the ear, the retrahent muscle will be easily found beneath the subcutaneous tissue, for it is stronger though deeper than the others.

Attrahens aurem muscle

The ATTRAHENS AUREM is a small fan-shaped muscle that *arises* from the fore part of the aponeurosis of the occipito-frontalis. Its fibres are directed backwards, and are *inserted* into a projection on the front of the rim of the ear. This muscle is united with the following at its origin, but a cellular interval exists between them near their insertion. Beneath it are the temporal vessels.

is united with next.

Attollens aurem muscle.

The ATTOLLENS AUREM has the same form as the preceding, though its fibres are longer and better marked. Arising also from the tendon of the occipito-frontalis, the fibres converge to their *insertion* into the inner or cranial surface of the pinna of the ear, — into an eminence corresponding to a fossa (that of the anti-helix) on the opposite aspect.

Retrahens aurem consists of two or three bundles.

The RETRAHENS AUREM (musculi retrahentes, Alb.) consists of two or three roundish, but separate bundles of fibres, which are stronger than those of the other muscles. The bundles *arise* from the root of the mastoid process, and pass almost transversely forwards to be *inserted* by aponeurotic

fibres into the lower part of the ear (concha) at its cranial aspect. The posterior auricular artery and nerve are in connection with this muscle.

The OCCIPITO-FRONTALIS MUSCLE covers the arch of the skull, and consists of an anterior and a posterior fleshy part, with an intervening tendon. Occipito-frontalis.

Dissection. — On the same side of the head (the left) the occipito-frontalis is to be dissected. To bring this muscle into view, a cut may be made along the middle line of the skull, from the root of the nose to a little below the occipital protuberance; and this may be connected in front with the transverse incision on the side of the head. The flap of skin, thus marked out, is to be raised from before and thrown backwards; whilst doing this the dissector will meet with first the anterior fleshy part of the muscle, next a white shining thin aponeurosis, and lastly the posterior fleshy belly towards the lateral aspect of the cranium. The student should bear in mind that the aponeurosis of the muscle is easily taken away with the granular fat superficial to it; and should the under surface of the flap of the integuments that is being detached have a white instead of a yellow appearance, he may infer he is removing that aponeurosis. Occipito-frontalis how seen: care to be taken.

The *anterior* or *frontal* part is a thin muscular expansion over the os frontis, which is not connected to the subjacent bone, but mixes below with some muscles of the face. Along the line of the eyebrow (its *origin*) the fibres are blended with those of the orbicularis palpebrarum and corrugator supercilii, whilst opposite the nose they join those of the pyramidalis nasi muscle. From this attachment the fibres are directed upwards to the aponeurosis, and end in it rather below the level of the coronal suture. Frontal part

The *posterior* or *occipital* part is stronger than the anterior; it *arises* from the mastoid portion of the temporal bone, and from the outer half or two-thirds of the upper curved line of the occipital bone. The fibres are about one inch and a half in length, and ascend to the aponeurosis. occipital part,

The *tendon*, or epicranial aponeurosis, extends over the upper part of the cranium, and is continuous across the middle line with the same structure of the opposite half of and aponeurosis.

the head. On the side it gives origin to the auricular muscles, and a thin membrane is here prolonged from it over the fascia covering the temporal muscle. Posteriorly, the aponeurosis is attached to the superior curved ridge of the occipital bone between the fleshy parts of the muscles of opposite sides. The aponeurotic expansion is closely attached to the skin; but it is connected to the pericranium only by a loose connective tissue devoid of fat, so that it moves freely over the skull.

Its connections. Superficial to the occipito-frontalis are the cutaneous vessels and nerves of the scalp. In front, the muscles of opposite sides are joined above the root of the nose.

How to see temporal fascia. *Dissection.* — After the removal of the superior auricular muscles and the temporal vessels, together with the epicranial aponeurosis and its lateral prolongation, the attachment of the temporal fascia on the side of the head may be seen.

Temporal fascia. The *temporal fascia* is a white, shining membrane, which is much stronger than the epicranial aponeurosis, and gives attachment to the subjacent temporal muscle. Attachments, Superiorly it is inserted into the curved line that limits the temporal fossa on the side of the skull; and inferiorly, where it is narrower and thicker, it is fixed to the zygoma. connections, By its cutaneous surface the fascia is in contact with the muscles already examined, and with the superficial temporal vessels and nerves. and layers. An incision in the fascia, a little above the zygoma, will show it to consist there of two layers, which are fixed to the margins of that process of bone. Between the layers is some fatty tissue, with a small branch of the temporal artery, and a slender twig of the orbital branch of the superior maxillary nerve.

To see temporal muscle. *Dissection.* — The temporal fascia is now to be detached from the subjacent muscle and the skull, and to be thrown down. A soft connective tissue that lies beneath it, near the zygoma, is then to be taken away. The difference in thickness of parts of the fascia will be evident.

Temporal muscle. The TEMPORAL MUSCLE is only in part laid bare. Wide and thin above, it becomes narrower and thicker at the lower part. The muscle *arises* from the temporal fascia, and from all the surface of the impression on the side of the Origin. skull, that is named the temporal fossa. From this origin

the fibres descend converging around a tendon, and are *inserted* by its means into the under surface of the coronoid process of the lower jaw. On the cutaneous surface is the temporal fascia, with the parts superficial to that membrane; and concealed by the muscle are the deep temporal vessels and nerves which ramify in it. The insertion of the muscle underneath the zygoma will be afterwards followed.

Insertion and connections.

Dissection.—For the dissection of the vessels and nerves let the head be turned to the left side, and let an incision be carried along the eyebrow and zygoma to a little behind the ear, in order that the piece of skin, on the opposite half of the head, may be removed. The flap of integument is then to be raised from before backwards, but the subcutaneous fat should be left till the nerves are found. Behind the ear the skin should be reflected as on the other side, so as to uncover the posterior auricular vessels and nerves.

How to reflect skin on right side.

Along the eyebrow seek the branches of vessels and nerves that come from the orbit, viz. the supra-orbital and frontal vessels, and the supra-orbital and supra-trochlear nerves. They lie at first beneath the muscular fibres, and the student must cut through these to find them: the supra-orbital branches issue opposite the middle, and the supra-trochlear near the inner part of the orbit.

Seek nerves and vessels in front;

On the side of the head, in front of the ear, the superficial temporal vessels and nerves are to be found; and somewhat above the zygoma are branches of the facial and superior maxillary nerves, whose offsets join. Behind the ear and below it, the posterior auricular vessels and nerve, and branches from the great auricular nerve to the tip and back of the ear, are to be seen; one or more offsets of the last should be traced to their junction with the posterior auricular nerve.

on side of head;

At the back of the head the ramifications of the occipital vessels, with the large and small occipital nerves, should be sought out; the former nerve lies by the side of the artery, and the latter about midway between this and the ear.

at back of head.

Cutaneous Vessels.—The arteries of the scalp are furnished by the internal and external carotid arteries, and anastomose freely over the side of the head. Only two small branches, the supra-orbital and frontal, come from the

Vessels of the scalp.

former; whilst several, viz. the temporal, occipital, and posterior auricular arteries belong to the latter.

Supra-orbital artery. The *supra-orbital artery* leaves the orbit through the notch in the margin of the orbit, and is distributed on the forehead. Some of its branches are superficial to the occipito-frontalis, and ascend towards the top of the head, whilst others remain beneath the muscle, and supply it, the pericranium, and the bone.

Frontal artery. The *frontal branch* is close to the inner angle of the orbit, and is much smaller than the preceding. It soon ends in branches for the supply of the muscles, integuments, and pericranium.

Superficial temporal has The *superficial temporal artery* is one of the terminal branches of the external carotid. After ascending over the zygoma for about two inches, the vessel divides on the temporal fascia into anterior and posterior branches.

anterior and The *anterior branch* runs forward with a serpentine course to the forehead, supplying muscular, cutaneous, and pericranial offsets, and anastomoses with the supra-orbital artery. This is the branch that is opened when blood is taken from the temporal artery.

posterior part. The *posterior branch* is larger than the other, and arches backwards above the ear towards the occipital artery, with which it anastomoses. Its offsets are similar to those of the anterior branch, and it communicates moreover with the artery of the opposite side over the top of the head.

Occipital artery. *Occipital Artery.*—The terminal part of this artery, after perforating the trapezius, divides into large and tortuous branches, which spread over the back of the head and the occipito-frontalis muscle. Communications take place with the artery of the opposite side, with the posterior part of the temporal, and with the following artery. Some offsets pass deeply to supply the muscle, the pericranium, and the bone.

Posterior auricular. The *posterior auricular artery* appears in front of the mastoid process, and divides into two branches. One (mastoid) is directed backwards to supply the occipito-frontalis, and anastomose with the occipital artery. The other (auricular) is furnished to the retrahent muscle and the back of the pinna of the ear; and an offset from it pierces the pinna to be distributed on the opposite surface.

The VEINS of the exterior of the head are so similar to the arteries, that a full notice of each is not required. All the veins corresponding to the branches of the internal carotid artery enter the facial vein, whilst the rest open into the jugular veins. These superficial veins communicate both with the sinuses in the interior of the skull by means of small branches named *emissary*, and with the veins occupying the spongy substance (diploë) of the cranial bones. Veins of the scalp,

The *frontal vein* is directed towards the inner angle of the orbit, where it receives the *supra-orbital* vein, the two giving rise to the angular vein of the face. Both the *superficial temporal* and *posterior auricular* veins open into the external jugular; and the *occipital* joins the internal jugular vein. like the arteries.

CUTANEOUS NERVES.—The several nerves are furnished from the terminal parts of both the cranial and spinal nerves. The half of the head anterior to the ear receives branches from the three trunks of the fifth cranial nerve, and a few offsets from the facial nerve. All the rest of the head is supplied by spinal nerves, from both their anterior and posterior primary branches, except close behind the ear, where there is an offset of the facial (seventh cranial) nerve. Nerves of the scalp are

The *supra-orbital nerve* comes from the first trunk of the fifth nerve, and escapes from the orbit with its companion artery; whilst beneath the occipito-frontalis muscle, the nerve gives offsets to this and the orbicularis palpebrarum, as well as others to the pericranium. Finally, the nerve ends in two cutaneous branches, which ramify between the epicranial aponeurosis and the skin:— Supra-orbital nerve;

One of these (inner) soon pierces the occipito-frontalis, and reaches upwards as far as the parietal bone. The other branch (outer) is of larger size, and perforating the muscle higher up, extends over the arch of the head to the os occipitis. Whilst the nerve is escaping from the supra-orbital notch it furnishes some *palpebral* filaments to the upper eyelid. In the orbicular muscle a communication is established between this and the facial nerve. its two cutaneous branches,

At the inner angle of the orbit is the small *supra-trochlear branch* of the same nerve. It turns upwards to the forehead close to the bone, and piercing the muscular fibres ends in the integument. Branches are given from it to the orbicularis and corrugator supercilii, and some *palpebral* twigs descend to the eyelid. and supra-trochlear branch.

Temporal nerves; The *superficial temporal nerves* are derived from the second and third trunks of the fifth nerve, and from the facial nerve.

from superior maxillary; *a.* The *temporal branch* of the *superior maxillary nerve* (second trunk of the fifth) is usually a slender twig, which perforates the temporal aponeurosis about a finger's breadth above the zygoma. When become cutaneous, the nerve is distributed on the temple, and communicates with the facial nerve, also sometimes with the next.

from inferior maxillary; *b.* The *auriculo-temporal branch* of the *inferior maxillary nerve* (third trunk of the fifth) is near the ear, and accompanies the temporal artery to the top of the head. As soon as the nerve emerges from beneath the parotid gland, it divides into two terminal branches: — the more posterior is the smaller of the two, and supplies the attrahens aurem muscle and the integument above the ear; the other branch ascends vertically to the top of the head, and is distributed over the epicranial and temporal aponeuroses. The nerve also furnishes an *auricular* branch (upper) to the anterior part of the ear, above the auditory meatus.

and from facial nerve. *c.* The *temporal branches* of the *facial nerve* are directed upwards over the temporal aponeurosis to the orbicularis palpebrarum muscle. They will be described with the dissection of the trunk of the facial nerve.

Posterior auricular nerve has The *posterior auricular nerve* lies behind the ear with the artery of the same name. It arises from the facial nerve close to the stylo-mastoid foramen, and ascends in front of the mastoid process. Soon after the nerve becomes superficial it communicates with the great auricular nerve, and divides into an occipital and an auricular branch, which are distributed as their names express: —

occipital branch, The *occipital branch* is long and slender, and ends in the posterior belly of the occipito-frontalis muscle. It lies near the occipital bone, enveloped in dense fibrous structure, and furnishes offsets to the integuments.

and auricular. The *auricular branch* ascends to the back of the ear, supplying the retrahent muscle and the posterior surface of the pinna.

Great auricular nerve. The *great auricular nerve* of the cervical plexus is seen to some extent at the lower part of the ear, but its anatomy will be afterwards given with the description of the cervical plexus.

The *great occipital* is the largest cutaneous nerve at the back of the head, and is recognised by its proximity to the occipital artery. Springing from the posterior primary branch of the second cervical nerve, it perforates the muscles of the back of the neck, and divides on the occiput into numerous large offsets; these spread over the posterior part of the occipito-frontalis muscle, ending mostly in the integument, and one small *auricular* branch reaches the cranial aspect of the ear. As soon as this nerve pierces the trapezius, it is joined by an offset from the third cervical nerve; and on the back of the head it communicates with the smaller occipital nerve.

Great occipital nerve **gives an auricular branch.**

The *small occipital nerve* of the cervical plexus lies midway between the ear and the preceding nerve, and is continued upwards in the integuments higher than the level of the ear. It communicates with the nerve on each side, viz. the posterior auricular and great occipital. Usually this nerve furnishes an *auricular* branch to the upper part of the ear at the cranial aspect, which supplies also the attollens aurem muscle.

Small occipital nerve **has an auricular branch.**

Dissection.—The skull is now to be opened, but before sawing the bone the dissector should detach on the right side the temporal muscle nearly down to the zygoma, without separating the fascia covering it; and all the remaining soft parts should be divided by an incision carried around the skull, about one inch above the margin of the orbit at the forehead, and as low as the protuberance at the occiput.

Dissection to open the skull.

The cranium is to be sawn in the same line as the incision through the soft parts, but the saw is to cut only through the outer osseous plate, and the inner plate is to be divided with a chisel, in order that the subjacent membrane of the brain (dura mater) may not be injured. The skull cap is next to be forcibly detached, and the dura mater will then come into view.

Precautions in cutting through bone.

SECTION II.

INTERNAL PARTS OF THE HEAD.

Directions.—It will be more advantageous for the student to proceed at once with the parts described in this *Section* than to examine the brain at this stage. Directions are

Course to be followed.

given (p. 12.) for the preservation of the brain, after its removal, till it can be dissected.

Dura mater.

The DURA MATER is the most external of the membranes investing the brain. It is a strong, fibrous structure, that serves as a periosteum to the bones, and supports the cerebral mass. Its outer surface is rough, and presents, now it is separated from the bone, numerous small fibrous and vascular processes; but these are most marked along the line of the sutures, where the attachment of the dura mater to the bone is much the most intimate. Ramifying on the upper part of the membrane are branches of the middle meningeal vessels, ascending towards the top of the head. Small granular fibrous bodies, glands of Pacchioni, are also seen along the middle line. The number of these bodies is very variable, and is increased with age. Occasionally the surface of the skull is indented by these so-called glands.

Appearance of outer surface.

Cut through the dura mater.

Dissection.—For the purpose of seeing the interior of the dura mater, divide this membrane with a scissors close to the margin of the skull, except in the middle line before and behind where the superior longitudinal sinus lies. The cut membrane is then to be raised towards the top of the brain; and on the right side the veins connecting it with the cerebral hemisphere may be broken through.

Inner surface.

When the dura mater has been cut through, its inner surface is seen to present a smooth and polished aspect; and this appearance is due to an epithelial covering, similar to that lining serous membranes.

Structure,

This external envelope of the brain consists of white fibrous tissue so disposed as to give rise to two distinct layers, viz., an external or periosteal, and an internal or special. At certain spots these layers are slightly separated, and form thereby the spaces or sinuses for the passage of the venous blood. Moreover, the innermost layer sends processes between different parts of the brain, forming the falx, tentorium, &c.

and processes.

Falx.

The *falx cerebri* is the process of the dura mater, in shape like a sickle, that dips in the middle line between the hemispheres of the cerebrum. Its form and extent will be evident if the right hemisphere is gently separated from it. It is narrow and pointed in front, where it is attached to the crista galli of the ethmoid bone, but widens posteriorly, and

Form and at-

joins a horizontal piece of the dura mater named the tentorium cerebelli. The upper border is convex, and is fixed to the middle line of the skull as far backwards as the occipital protuberance; and the lower, or free border, is concave, and turned towards the corpus callosum of the brain, with which it is in contact posteriorly. In this fold of the dura mater are contained the following sinuses:—the superior longitudinal along the convex border, the inferior longitudinal in part of the lower edge, and the straight sinus at the line of junction between it and the tentorium. tachments. Sinuses in it.

The *superior longitudinal sinus* extends from the ethmoid bone to the occipital protuberance. Its position in the convex border of the falx will be made manifest by the escape of blood through numerous small veins, if the finger is carried backwards along the middle line of the head. When the sinus is opened, it is seen to be narrow in front, and to become wider as it proceeds backwards, till it ends in a common point of union of certain sinuses (torcular Herophili) at the centre of the occipital bone. Its cavity is triangular in form, with the apex of the space turned to the falx; and across it are stretched small tendinous cords—chordæ Willisii, near the openings of some of the cerebral veins. Occasionally small glandulæ Pacchioni are present in the sinus. Superior longitudinal sinus. Situation and ending. Its interior.

This sinus receives small veins from the substance and exterior of the skull, and larger ones from the hemispheres of the brain. The cerebral veins open chiefly at the posterior part of the brain, and lie for some distance against the wall of the sinus before they perforate it; their course is likewise directed from behind forwards, so that the motion of the blood in them is evidently opposed to the direction of the current in the sinus. This disposition of the veins may be seen on the left side of the brain, where the parts are undisturbed. Veins opening into it. Current of blood in it.

Dissection.—Before the rest of the dura mater can be seen, the brain must be taken from the body. To facilitate its removal, let the head incline backwards, whilst the shoulders are raised on a block, so that the brain may be separated somewhat from the base of the skull. Cut across now the anterior part of the falx cerebri, and the different cerebral veins entering the longitudinal sinus; raise and throw backwards the falx, but leave it uncut behind, where it is con- Dissection for removal of brain.

nected with the rest of the dura mater. For the division of the nerves of the brain, a sharp scalpel will be necessary; and the nerves are to be cut longer on the one side than on the other.

Mode of proceeding and parts cut in succession.

Removal of the brain. — Begin the removal of the brain by gently raising with the fingers the anterior lobes and the olfactory bulbs. Next cut through the internal carotid artery and the second and third nerves, which first present themselves to the dissector; the large second nerve is on the inner, and the round third nerve on the outer side of the artery. A small branch of artery to the orbit should likewise be divided at this time. The brain is now to be supported in the left hand, and the pituitary body to be dislodged with the knife from the hollow in the centre of the sphenoid bone. Afterwards a strong horizontal process of the dura mater (tentorium cerebelli) comes into view; and along its free margin will be seen the small fourth nerve, which is to be cut at this stage of the proceeding. Next make an incision through the tentorium on each side, close to its attachment to the temporal bone, without injuring the parts underneath. The following nerves, which now appear, are to be divided in succession. Near the inner margin of the tentorium is the fifth nerve, consisting of a large and small root; whilst towards the middle line of the head is the long slender sixth nerve. Below the fifth, and somewhat external to it, is the seventh nerve with its facial and auditory parts, the former being anterior and the smaller of the two. Directly below the seventh are the three trunks of the eighth nerve in one line: — of these, the upper small piece is the glosso-pharyngeal; the flat band next below, the pneumogastric; and the long round nerve ascending from the spinal canal, the spinal accessory. The remaining nerve is the ninth, which consists of two small pieces. After dividing the nerves, cut through the vertebral arteries as they wind round the upper part of the spinal cord. Lastly, cut across the spinal cord as low as possible, as well as the roots of the spinal nerves that are attached on each side. By placing the right first two fingers in the spinal canal, the cord may be raised, and the whole brain may then be taken readily from the skull in the left hand.

How to preserve

Its preservation. — The brain may be immersed in spirit

to harden the texture, and methylated spirit may be used on account of its cheapness. To allow the spirit to reach the interior of the ventricles, the upper part of each hemisphere is to be cut off nearly to the level of the corpus callosum; and then each lateral ventricle is to be opened by a longitudinal incision, about two inches long, near the inner margin of the divided hemisphere, and about midway from before back. Now placing the brain upside down on a piece of calico long enough to wrap over it, set it aside in the spirit, together with the top of one hemisphere. the brain.

Its examination.—At the end of one day the dissector should return to the examination of the other membranes and the vessels. As soon as the vessels have been learnt, the membranes are to be carefully removed from all the surface of the brain, without detaching the different cranial nerves. Finally, the brain may remain in the spirit till the dissection of the head and neck has been completed. The description of the brain will be found after that of the head and neck. Examination of it. Its description.

Directions.—After setting aside the brain, the anatomy of the dura mater, and the vessels and nerves in the base of the skull, should be proceeded with. Let the head be raised to a convenient height, and the tentorium be fastened in its natural position with a few stitches. The dissector should be furnished with the base of a skull, whilst studying the following parts. Directions.

Dura mater.—At the base of the cranium the dura mater is much more closely united to the bones than it is at the top of the skull. Here it dips into the different inequalities on the osseous surfaces; it also sends processes through the several foramina, which join for the most part the pericranium, and furnish sheaths to the nerves. Beginning the examination in front, the student will find the membrane sending a prolongation into the foramen cæcum, as well as a series of tubes through the apertures in the cribriform plate of the ethmoid bone. Through the sphenoidal fissure, a large process enters the orbit, and a covering is continued on the optic nerve to the eyeball. After lining the sella Turcica, the dura mater adheres closely to the basilar process of the occipital bone; and it may be traced into the spinal Dura mater in base of skull; its prolongations and connections to bone.

canal through the foramen magnum, to the margin of which it is very firmly connected.

Tentorium cerebelli; its attachments

The *tentorium cerebelli* is the piece of the dura mater that is interposed in a somewhat horizontal position between the cerebellum and the posterior part of the cerebrum. Its upper surface is raised along the middle, where it is joined by the falx cerebri, and is hollowed laterally for the reception of the back part of the cerebral hemispheres; its under surface corresponds to the little brain and the falx cerebelli. The anterior margin is free, except at the ends where it is fixed by a narrow slip to each anterior clinoid process. The posterior or attached part is connected to the following bones: — occipital (its transverse groove), inferior angle of the parietal, petrous portion of the temporal (upper border),

and the sinuses in it.

and posterior clinoid process of the sphenoid. Along the centre of the tentorium is the straight sinus, whilst in the attached edge are the lateral and the superior petrosal sinuses.

Falx cerebelli

The *falx cerebelli* has the same position below the tentorium as the falx cerebri above that fold. It is much smaller than the like process of the cerebrum, and will be seen by detaching the tentorium. Triangular in form, this fold is attached to the middle of the occipital bone, below the transverse ridge, and projects between the hemispheres of the cerebellum. Its base is directed to the tentorium, and the

contains occipital sinuses.

apex ends below, at the foramen magnum, to each side of which it gives a small slip. In it are contained the occipital sinuses.

Sinuses of the skull.

The SINUSES are venous spaces between the layers of the dura mater, into which the blood is received. All the sinuses open either into a large space named torcular Herophili, opposite the occipital protuberance, or into the two cavernous sinuses by the sides of the body of the sphenoid bone.

Occipital centre receives

A. The TORCULAR HEROPHILI is placed in the tentorium, opposite the centre of the occipital bone. It is of an irregular shape, and numerous sinuses open into it; viz. the superior longitudinal above, and the occipital below; the straight and inferior longitudinal in front, and the lateral sinus on each side.

The *superior longitudinal sinus* has been already described (see p. 11.). Superior and

The *inferior longitudinal sinus* resembles a small vein, and is contained in the lower border of the falx cerebri at the posterior part. This vein receives blood from the falx and the larger brain, and ends in the straight sinus at the edge of the tentorium. Inferior longitudinal.

The *straight sinus* lies along the middle of the tentorium and seems to continue the preceding sinus to the common point of union. Its form is triangular, like the superior longitudinal. Joining it are the inferior longitudinal sinus, the veins of Galen from the interior of the large brain, and some small veins from the upper part of the small brain. Straight sinus.

The *occipital sinus* is a small space in the falx cerebelli, which reaches to the foramen magnum, and collects the blood from the occipital fossæ. This sinus may be double. Occipital sinus.

The *lateral sinus* is the channel by which most of the blood passes from the skull. There is one on each side, right and left, which extends from the occipital protuberance to the foramen jugulare, where it ends in the internal jugular vein. Lateral sinus. In this extent the sinus corresponds to the winding groove in the interior of the skull, between the two points of bone before mentioned. Position to bone. Besides small veins from the brain, it is joined by the superior petrosal sinus opposite the upper border of the petrous portion of the temporal bone, and by the inferior petrosal at the foramen jugulare. Sinuses joining it. Oftentimes it communicates with the occipital vein through the mastoid foramen, and sometimes with the veins of the diploë of the skull. The right sinus is often larger than the left.

The foramen jugulare is divided into three compartments by bands of the dura mater; through the posterior interval the lateral sinus passes, through the anterior the inferior petrosal sinus, and through the central one the eighth nerve. Situation in foramen jugulare.

Dissection.—To examine the cavernous sinus, say on the left side, let the dura mater opposite the body of the sphenoid bone be cut through from the anterior to the posterior clinoid process, and internal to the position of the third nerve. Behind the last-named process, let the knife be directed inwards for about half the width of the basilar part of the occipital bone. By placing the handle of the scalpel Dissection.

in the opening thus made, the extent of the space will be defined. A probe should be passed into the different sinuses that join the cavernous centre.

Cavernous sinus

B. The CAVERNOUS SINUS, which has been so named from the reticulate structure in its interior, is situate on the side of the body of the sphenoid bone. This space, resulting from the separation of the layers of the dura mater, is of an irregular shape, and extends from the sphenoidal fissure to the tip of the petrous portion of the temporal bone. The piece of dura mater bounding the sinus externally is of some thickness, and contains in its substance the third and fourth nerves, with the orbital trunk of the fifth nerve. The cavity of the sinus is larger behind than before, and in it are shreds of fibrous tissue with small vessels. Through the space winds the trunk of the internal carotid artery, with the sixth nerve on the outer side of the vessel; but these are shut out from the blood in the space by the thin lining membrane. The cavernous sinus receives the ophthalmic vein of the orbit, some small cerebral veins, and twigs from the pterygoid veins outside the skull. It communicates with its fellow on the opposite side by the circular and transverse sinuses, and its blood is transmitted to the lateral sinus by the superior and inferior petrosal channels.

has nerves in outer wall; contains carotid artery and sixth nerve; and is joined by the following sinuses, viz.

Circular sinus,

The *circular sinus* lies around the pituitary body, and reaches from the one cavernous sinus to the other across the middle line. Besides serving as the means of communication between those sinuses, it receives small veins from the pituitary body. This sinus is usually destroyed by the removal of the pituitary body.

Transverse sinus,

The *transverse* or *basilar sinus* crosses the basilar process of the occipital bone, on a level with the petrous part of the temporal bone, and joins the opposite cavernous sinuses. A second transverse sinus is sometimes found nearer the foramen magnum.

Superior petrosal,

The *superior petrosal sinus* lies in a groove in the upper margin of the petrous part of the temporal bone, and extends between the cavernous and lateral sinus. A small vein from the cerebellum, and another from the internal ear, are received into it.

Inferior petrosal.

The *inferior petrosal sinus* extends between the same sinuses as the preceding, and lies in a groove along the line

of junction of the petrous part of the temporal with the basilar process of the occipital bone; it is joined by a small vein from the outside of the skull, through the foramen lacerum (medium) at the base of the cranium. The sinus passes through the anterior compartment of the jugular foramen, and ends in the internal jugular vein.

MENINGEAL ARTERIES.—The arteries supplying the dura mater and the cranium are found in the three fossæ of the base of the skull, and may be named from their situation, anterior, middle, and posterior meningeal. Arteries of dura mater are;—

The *anterior meningeal* are two very small branches which come from the ethmoidal arteries (p. 50.): they enter the skull by apertures between the frontal and ethmoid bones, and are distributed to the dura mater near the ethmoid bone. Anterior meningeal.

The *middle meningeal* arteries are three in number: two, that are named large and small, are derived from the internal maxillary trunk; and the third is an offset of the ascending pharyngeal artery. Middle meningeal,

The *large meningeal branch* of the internal maxillary artery enters the skull by the foramen spinosum of the sphenoid bone, and ascends towards the anterior inferior angle of the parietal bone. At this spot the vessel enters a deep groove in the cranium, and ends in ramifications that spread over the side of the head, some of these reaching to the top, and others towards the occiput. Two *veins* run with this artery. from internal maxillary;

Branches.—As soon as the artery enters the cranial cavity, it furnishes branches to the dura mater and osseous structure, and to the ganglion of the fifth nerve. One small offset, *petrosal*, enters the hiatus Fallopii, and extends through the aqueduct of the same name till it meets the stylo-mastoid artery. One or two branches enter the orbit, and anastomose with the ophthalmic artery. gives branches to dura mater and ear.

The *small meningeal* branch is an offset of the large one outside the skull, and is transmitted through the foramen ovale to the membrane lining the middle cranial fossa. Small meningeal;

The other *meningeal branch* from the ascending pharyngeal artery, appears in the middle fossa of the skull, after passing through the foramen lacerum (basis cranii). from ascending pharyngeal.

Posterior meningeal

The *posterior meningeal branches* are likewise small, and are furnished by the occipital and vertebral arteries.

from occipital and vertebral.

Those from the occipital, one on each side, enter the skull by the jugular foramen; and those from the vertebral arise opposite the foramen magnum. Both sets ramify in the posterior fossa of the skull.

Nerves of dura mater.

MENINGEAL NERVES.—The source of the nerves of the dura mater is very uncertain. Offsets to it are derived from both the cranial and sympathetic nerves. To make these nerves apparent, it would be necessary to steep the dura mater in diluted nitric acid.*

Cranial nerves in base of skull:

CRANIAL NERVES.—The cranial nerves pass from the encephalon through apertures in the base of the skull. As each leaves the cranium it is invested by processes of the membranes of the brain, which are thus disposed:—those of the dura mater and pia mater are lost on the nerve; whilst that of the arachnoid membrane is reflected back, after a short distance, to the interior of the skull. Some of the nerves, those in the middle fossa of the skull for instance, are received into sheaths of the dura mater before they approach the foramina of transmission. For the present the nerves will be referred to as nine in number, but notice will be subsequently taken of a different mode of enumerating them.

only partly seen.

Only part of the course of each nerve will be now seen, the rest must be learnt in the dissection of the base of the brain.

Olfactory nerve,

The FIRST NERVE ends anteriorly in the enlargement of the olfactory bulb. This swelling lies on the cribriform plate of the ethmoid bone, and supplies about twenty filaments to the nose through the small foramina in the subjacent bone. These delicate nerves are surrounded by prolongations of the membranes of the brain, whose disposition will be noticed in the dissection of the nose.

ends in the nose.

Optic nerve

The SECOND NERVE diverging from its commissure to the

* Many of the cranial nerves are said to supply the dura mater; and the student who is desirous for further information may consult Professor Kölliker's *Mikroskopische Anatomie*, p. 495.

eyeball, is seen entering the orbit through the optic foramen: accompanying the nerve is the ophthalmic artery. enters the eye.

Dissection.—The third, fourth, and the ophthalmic trunk of the fifth nerve lie in the outer wall of the cavernous sinus; and it will be necessary, in order to see them, to remove the sheaths of the dura mater that they receive. Dissection of third and fourth nerves;

Afterwards the student should follow outwards the roots of the fifth nerve into the middle fossa of the skull, and take away the dura mater from the surface of the large Gasserian ganglion which lies on the point of the petrous part of the temporal bone. And the two large trunks that leave the front of the ganglion, viz. superior and inferior maxillary, should be traced to their apertures of exit from the skull. of fifth nerve.

The THIRD NERVE is destined for the muscles of the orbit. It enters the wall of the cavernous sinus near the anterior clinoid process, and is deprived at that spot of its tube of arachnoid membrane. In the wall of the sinus it is placed above the other nerves; but when it is about to enter the orbit through the sphenoidal fissure, it lies below the fourth and part of the fifth, and divides into two branches. Near the orbit this nerve is joined by one or two delicate filaments of the cavernous plexus (p. 22.). Motor-oculi nerve passes to orbit.

The FOURTH NERVE courses forwards, like the preceding, to one muscle in the orbit. It is the smallest of the nerves in the wall of the sinus, and lies below the third; but as it is about to pass through the sphenoidal fissure it becomes higher than all the other nerves. In the wall of the sinus the fourth nerve is joined by twigs of the sympathetic, and it is sometimes united with the ophthalmic trunk of the fifth. Trochlear nerve in the wall of cavernous sinus.

FIFTH NERVE. — This nerve is distributed to the face and head, and consists of two parts or roots — a large or sensory, and a small or motory. The two roots of the nerve pass together through an aperture in the dura mater, into the middle fossa of the base of the skull. Immediately afterwards the larger root enters into the Gasserian ganglion, whilst the smaller root passes beneath the ganglion, without communicating with it, and joins only one of the three trunks derived from the ganglion. Trifacial nerve has two roots, their arrangement.

The *ganglion of the root of the fifth nerve* (Gasserian ganglion) is placed in a depression on the point of the petrous part of the temporal bone. The upper surface of the gan- Gasserian ganglion on large root,

glion is closely united to the dura mater, and presents a semi-lunar elevation, whose convexity looks forwards. Some filaments from the plexus of the sympathetic on the carotid artery enter its inner side.

gives three branches.

Branches.— From the front of the ganglion proceed the three following trunks: — The ophthalmic nerve is the first and highest, and is destined for the orbit and face. Next in order is the superior maxillary nerve, which leaves the skull by the foramen rotundum, and ends in the face below the orbit. And the last, or the inferior maxillary nerve, passes downwards through the foramen ovale to reach the lower jaw, the lower part of the face, and the tongue. If the ganglion be raised, the small root will be seen passing beyond it to enter the trunk of the inferior maxillary nerve.

Difference in the branches.

In consequence of this partial blending of the roots, those branches of the ganglion that are unconnected with the smaller or motor root, viz. the ophthalmic and superior maxillary, are solely nerves of sensibility; but the inferior maxillary, which is compounded of both, is a nerve of sensibility and motion, like a spinal nerve. It is not, however, the whole of the inferior maxillary nerve that has this double function, for the motor root is mixed almost exclusively with the part of the trunk which supplies the muscles of the lower jaw; and it is, therefore, only that small part of the nerve which possesses a twofold action, and resembles a spinal nerve.

Ophthalmic nerve of ganglion enters orbit;

The *ophthalmic nerve* is the only one of the three trunks that needs a more special notice in this stage of the dissection. It enters the orbit through the sphenoidal fissure, and is continued through that space to the forehead. In form it is a flat band; and in its course to the orbit the nerve is contained in the wall of the cavernous sinus, where it lies beneath the third and fourth nerves. In this situation it is joined by filaments of the cavernous plexus of the sympathetic, and gives a small *rècurrent* filament to that part of the dura mater which forms the tentorium cerebelli (Arnold). Near the orbit it divides into three branches. (See p. 45.)

supplies dura mater.

Abducens nerve is in cavernous sinus.

The SIXTH NERVE enters the orbit through the sphenoidal fissure, and supplies one of the orbital muscles. It pierces the dura mater behind the body of the sphenoid bone, and crosses the space of the cavernous sinus in its course to the

orbit, instead of lying in the outer wall with the other nerves. In the sinus, the nerve is placed close against the outer side of the carotid artery; and it is joined by one or two branches of the sympathetic nerve surrounding that vessel.

Seventh nerve has two parts.

SEVENTH NERVE.— This cranial nerve consists of two trunks, facial and auditory, and both enter the meatus auditorius internus. In the bottom of the meatus they separate; the facial nerve courses through the aqueduct of Fallopius to the face, whilst the auditory nerve is distributed to the internal ear.

Eighth nerve has three parts.

EIGHTH NERVE.— Three trunks are combined in the eighth cranial nerve of Willis, viz. glosso-pharyngeal, pneumo-gastric, and spinal accessory. All three pass through the central compartment of the foramen jugulare, but all are not contained in one tube of either the dura mater or the arachnoid membrane. The glosso-pharyngeal nerve is external to the other two, being separated from them by the inferior petrosal sinus, and has distinct sheaths of the dura mater and the arachnoid membrane; but the pneumo-gastric and spinal accessory nerves are inclosed in the same tube of the dura mater, only a piece of the arachnoid intervening between them.

Their passage through foramen jugulare.

Ninth nerve.

The NINTH NERVE is the motor nerve of the tongue, and consists of two small pieces, that pierce separately the dura mater opposite the anterior condyloid foramen; these unite after passing through that aperture.

Dissection of carotid,

Dissection.— The dissector may now return to the examination of the trunk of the carotid artery, as it winds through the cavernous sinus.

of sympathetic plexuses.

On the opposite side, viz. that on which the nerves in the wall of the cavernous sinus are untouched, an attempt may be made to find two small plexuses of the sympathetic on the carotid artery. One of these (cavernous) is on the artery near the root of the anterior clinoid process; and to bring it into view it will be necessary to cut off that piece of bone, and to dissect out with care the third, fourth, fifth, and sixth nerves, looking for filaments between them and the plexus. Another plexus (carotid), joining the fifth and sixth nerves, surrounds the artery as this enters the sinus. In an injected body this dissection is scarcely possible.

Internal carotid artery, The INTERNAL CAROTID ARTERY appears in the base of the skull at the apex of the petrous part of the temporal bone. In its ascent to the brain the vessel lies in the space of the cavernous sinus, along the side of the body of the sphenoid bone, and makes two remarkable bends, so as to look like the letter S reclined. On entering the sinus, the artery ascends, at first, to the posterior clinoid process; it is then directed forwards to the root of the anterior process of the same name; and lastly, it turns upwards internal to this point of bone, perforates the dura mater bounding the sinus, and divides into cerebral arteries at the base of the brain. In this course the artery is enveloped by nerves derived from the sympathetic in the neck.

winds through cavernous sinus.

The branches are to dura mater and orbit. The *branches* of this part of the artery are few. In the sinus there are some small arteries (arteriæ receptaculi) for the supply of the dura mater and the bone, the nerves, and the pituitary body; and opposite the anterior clinoid process the ophthalmic branch arises. The terminal branches of the carotid will be seen in the dissection of the base of the brain.

Sympathetic on carotid forms SYMPATHETIC NERVE.— Around the carotid artery is a prolongation of the sympathetic nerve of the neck, which forms the following plexuses: —

carotid plexus, The *carotid plexus* is situate on the outer side of the vessel, at its entrance into the cavernous sinus, and communicates with the sixth nerve, and with the Gasserian ganglion.

cavernous plexus. The *cavernous plexus* is placed below the bend of the artery, which is close to the root of the anterior clinoid process. This small plexus is more immediately connected with the offset of the upper cervical ganglion of the sympathetic, that courses along the inner side of the carotid artery. Filaments are given from this plexus to unite with the third, fourth, and ophthalmic nerves. One filament is also furnished to the lenticular ganglion, either separately from, or in conjunction with the nasal nerve.

Union with cranial nerves.

Distribution. After forming these plexuses, the nerves surround the trunk of the carotid, and are lost in the cerebral membranes.

Two petrosal nerves in base of skull. *Petrosal nerves.*— Beneath the Gasserian ganglion is the *large superficial petrosal nerve*, entering the hiatus Fallopii to join the facial nerve. External to this is occasionally seen another small *petrosal* nerve (nervus petrosus superficialis tertius, Bidder), which springs from the sympathetic on the middle meningeal artery, and enters the bone to join the facial nerve with the preceding. A

third *petrosal* nerve is contained in the substance of the temporal bone.

The source and the connections of these small nerves will be afterwards learnt. It will suffice now for the student to note them, and to see that they are kept moist and preserved fit for examination at a future time.

Directions. — Now the base of the skull has been examined, a preservative fluid should be applied, and the flaps of integuments should be stitched together over all. For preservation of parts.

Section III.

DISSECTION OF THE FACE.

Directions. — The left side of the face may be used for the muscles and vessels, and the right side is to be reserved for the nerves. Directions.

Position. — The previous position of the body for the examination of the base of the skull will require to be changed. The head is to be lowered, and the side of the face to be dissected is to be placed upwards. Position of body.

Dissection. — As a preparatory step, the muscular fibres of the eyelids, lips, and side of the nose, are to be slightly stretched by inserting a small quantity of tow or cotton wool into the different apertures; and the margins of the eyelids and lips are then to be fastened with a few sutures. Dissection.

The integument is to be removed from the left side of the face by means of the following incisions: — one is to be made in front of the ear, from above the zygoma to the angle of the jaw; and another is to be continued from the last point along the base of the jaw to the chin. The flap of skin is to be raised from behind forwards, and left adherent along the middle line. Much care must be taken in detaching the skin from the thin, and oftentimes pale fibres of the orbicular muscle of the eyelids, otherwise these will be cut away in consequence of the little connective tissue that intervenes between the two. On the side of the nose the skin is closely united to the subjacent parts, and must be detached with caution. Around the mouth are also many fleshy slips that extend both upwards and downwards from the orbicular muscle, but they are all marked so distinctly as to escape How to raise skin from muscle of eyelid, side of nose, and around mouth.

injury, except the small risorius muscle that comes from the angle of the lower jaw towards the corner of the mouth. When removing the fat from these muscles, each fleshy slip may be made tense with hooks.

Facial vessels

The facial vessels and their branches will come into view as the parts are cleaned; but the nerves may be disregarded on this side.

and parotid.

Near the ear is the parotid gland, whose duct is to be preserved; this is on a level with the meatus auditorius, and pierces the middle of the cheek.

In the face the muscles surround the apertures.

Muscles of the Face.—The superficial muscles of the face are gathered around the apertures of the eye, nose, and mouth. An orbicular or sphincter muscle surrounds the apertures of both the eye and mouth; and other muscles are blended with each to enlarge the opening in the centre of the fibres. There are three distinct groups of muscles: one of the opening of the eyelids; another of the nostril; and a third of the aperture of the mouth. One of the muscles of mastication, viz. the masseter, is also now seen, but it will be afterwards examined.

Four muscles of eyelids.

Muscles of the Eyelids.—The muscles of the eyelids are four in number, viz. orbicularis palpebrarum, corrugator supercilii, levator palpebræ superioris, and tensor tarsi.* The two latter are dissected in the orbit, and will be described with that part.

Orbicularis palpebrarum

The orbicularis palpebrarum is the sphincter muscle of the elliptical opening between the eyelids. It is a flat and thin layer, which extends from the margin of the lids beyond the circumference of the orbit.

arises internally,

At the inner angle of the orbit the muscle is fixed to the surface and borders of the small tendo palpebrarum or tarsal ligament; above that tendon, to the nasal process of the upper maxillary bone, and to the internal angular process of the frontal bone; and below it, to the same process of the superior maxillary bone, and to the inner part of the margin of the orbit. From this origin the fibres are directed outwards, giving rise to ovals, which lie side by side, and increase in size towards the

* The tensor tarsi muscle (p. 52.) is sometimes described as part of the orbicularis.

outer margin of the muscle. The external fibres (orbital) are the strongest, and project beyond the margin of the orbit; the internal fibres (ciliary) are very pale and thin, and form a small bundle close to the cilia or eyelashes; whilst the fibres which occupy the eyelids (palpebral), are intermediate in size. The external fibres pass continuously around the margin of the orbit; but those in the eyelids are interrupted externally, and are fixed to the external tarsal ligament and the malar bone. The muscle is subcutaneous, and its circumference is free, except above, where it is blended with the occipito-frontalis. Beneath the upper half of the orbicularis, as it lies on the margin of the orbit, is the corrugator supercilii muscle with the supra-orbital vessels and nerve; and beneath the lower half is part of the elevator of the upper lip. The outer fibres are sometimes joined by slips to the other contiguous muscles.

and consists of three sets of fibres.

Difference in attachment.

Connection with parts around.

The CORRUGATOR SUPERCILII is found beneath the orbicularis, near the inner angle of the orbit. Its fibres *arise* from the inner part of the superciliary ridge of the frontal bone, and are directed thence outwards to join the orbicular muscle about the middle of the orbital arch. It is a short muscle, and is distinguished by the closeness of its fibres.

Corrugator supercilii is blended with orbicularis.

MUSCLES OF THE NOSE.—The muscles of the nose are the following: pyramidalis nasi, compressor naris, levator alæ nasi, with some fibres that dilate the nostril, and depressor alæ nasi.

Four muscles of nose.

The PYRAMIDALIS NASI is a small pyramidal slip that covers the nasal bone, and appears to be a prolongation of the occipito-frontalis muscle. Over the cartilaginous part of the nose its fibres end in an aponeurosis, which joins that of the compressor naris. Along its inner border is the muscle of the opposite side.

Pyramidalis nasi is over nasal bone.

COMPRESSOR NARIS.—This muscle is not well seen till after the examination of the following one. Triangular in shape, it *arises* by a point from the canine fossa of the upper maxillary bone. The fibres are directed inwards, spreading out at the same time, and end in an aponeurosis, which covers the cartilaginous part of the nose, and joins the tendon of the opposite muscle. This muscle is partly concealed by the

Compressor naris covers cartilage of nose.

next one — the common elevator of the ala of the nose and the upper lip.

Elevator of wing of nose

The LEVATOR LABII SUPERIORIS ALÆQUE NASI is placed by the side of the nose, and *arises* from the nasal process of the upper maxillary bone, internal to the attachment of the orbicularis. As the fibres descend from the inner part of the orbit, the most internal are attached by a narrow slip to the wing of the nose, whilst the rest are blended inferiorly with those of the orbicularis oris. Near its origin the muscle is partly concealed by the orbicularis palpebrarum, but in the rest of its extent it is subcutaneous; its outer border joins the elevator of the upper lip.

is part elevator of upper lip.

Dilator of nostril.

Dilatator Naris.—In the dense tissue on the outer side of the nostril, are found a few muscular fibres both at the fore and back part of that aperture, to which the above name has been given by Theile: they are seldom visible without a lens. The *anterior* slip passes from the cartilage of the aperture to the integument of the margin of the nostril; and the *posterior* arises from the upper jawbone and the small sesamoid cartilages and ends in the integuments of the nostril.

anterior and posterior parts.

Depressor of wing is seen from mouth.

The DEPRESSOR ALÆ NASI is found beneath the mucous membrane on the side of the frænum of the upper lip. It *arises* below the nose from a depression of the upper jawbone before the roots of the second incisor and canine teeth; and ascends to be *inserted* into the septum and the posterior part of the ala of the nose.

Muscles of the mouth.

MUSCLES OF THE MOUTH.—The muscles that act on the aperture of the mouth consist of a sphincter; an elevator of the upper lip, and of the angle of the mouth; depressors of the lower lip, and of the angle of the mouth, with an elevator of the lower lip; together with other small muscles that act on the corner, viz. zygomatici and risorius of Santorini. Lastly, the buccinator muscle may be reckoned in this set, as it acts indirectly on the corner of the mouth.

Sphincter of mouth

The ORBICULARIS ORIS MUSCLE surrounds the external opening of the mouth, and is constructed for the most part by the fibres of the several muscles acting on that aperture. It consists of two parts, inner and outer, which differ much in the appearance and arrangement of the fibres.

consists of two parts,

The *inner* part, whose fibres are pale in colour and fine in texture, forms a rounded thick fasciculus that reaches outwards from the margin of the lip to the arch of the coronary artery. The fibres of this portion of the muscle are unattached to bone, and some pass from lip to lip round the corner of the mouth. inner or circular,

The *outer* part is thin, wide, and more irregular in form, and has an attachment to the subjacent bone, besides its connection with the adjacent muscles. In the upper lip it is attached, on each side of the middle line, by one slip (naso-labial) to the back of the septum of the nose, and by another to the outer surface of the alveolar margin of the upper jaw opposite the canine and incisor teeth, external to the depressor of the wing of the nose. And in the lower lip it is fixed on each side into the inferior jawbone, on the outer aspect, opposite the canine tooth, or external to the levator labii inferioris muscle. To see these attachments the lip must be everted, and the mucous membrane carefully raised. outer or irregular.

The inner margin of the muscle is free, and bounds the aperture of the mouth; whilst the outer edge blends with the different muscles that elevate or depress the lips and the angle of the mouth. Beneath the orbicularis in each lip is the coronary artery, with the mucous membrane and the labial glands. Connections: blends with other muscles.

The LEVATOR LABII SUPERIORIS extends vertically from the lower margin of the orbit to the orbicularis oris. It *arises* from the upper maxillary and malar bones, above the infra-orbital foramen, and blends with the orbicularis oris, between the middle line and the angle of the mouth. Near the orbit the muscle is overlapped by the orbicularis palpebrarum, but below that spot it is subcutaneous. By its inner side it joins the common elevator of the ala of the nose and upper lip; and to its outer side lie the zygomatic muscles. Beneath it are the infra-orbital vessels and nerve. Elevator of upper lip passes from the orbit to mouth. Connections.

The LEVATOR ANGULI ORIS has well-marked fibres, and is partly concealed by the preceding muscle. Arising from the canine fossa, beneath the infra-orbital foramen, its fibres spread out towards the angle of the mouth, where they are superficial to the buccinator, and mix with the rest of the Elevator of the angle mixes with de-

pressor of angle. muscles, but the greater number are continued into the depressor anguli oris and the lower lip.

Depressor of lower lip The DEPRESSOR LABII INFERIORIS is opposite the elevator of the upper lip, and has much yellow fat mixed with its fibres. The muscle takes its *origin* from a depression on the front of the lower jaw, reaching backwards from near the symphysis to a little beyond the hole for the labial vessels and nerve; ascending thence it is blended with the is in the middle of chin. orbicularis in the lower lip. Its inner border joins the muscle of the opposite side, and its outer is overlapped by the depressor anguli oris.

Depressor of angle The DEPRESSOR ANGULI ORIS is triangular in shape, and passes from the oblique line on the outer surface of the lower jaw to the angle of the mouth, where its fibres are continued is a strong muscle. into the elevators of the angle. This muscle conceals the labial branch of the inferior dental vessels and nerve. At its origin the depressor is united with the platysma myoides, and at its insertion with the risorius muscle.

Elevator of chin The LEVATOR LABII INFERIORIS is a small muscle on the side of the frænum of the lower lip, which is opposite to the depressor of the ala of the nose in the upper lip. When is seen inside mouth. the mucous membrane has been removed, this muscle will be seen to *arise* from a fossa near the symphysis of the lower jaw, and to descend to its *insertion* into the integument of the chin. Its position is internal to the depressor of the lip, and the attachment of the orbicularis.

Zygomatic muscles; The ZYGOMATIC MUSCLES are directed obliquely from the arch of the same name towards the angle of the mouth. One is longer and larger than the other; hence the names major and minor.

large The *zygomaticus major* arises from the outer part of the malar bone at the union with the temporal, and is inserted into the angle of the mouth.

and small: The *zygomaticus minor* is attached to the malar bone anterior to the other, and blends with the fibres of the special elevator of the upper lip.

Risorius muscle The RISORIUS MUSCLE (Santorini) is a thin and narrow bundle of fibres, sometimes divided into two or more parts, is almost transverse. which arises externally from the fascia over the masseter muscle, and is connected internally with the apex of the depressor anguli oris.

The BUCCINATOR is a flat and wide muscle, that occupies the interval between the jaws, and bounds in this direction the cavity of the mouth. The muscle *arises* from the outer surface of the alveolar borders of the upper and lower maxillæ, as far forward in each as the first molar tooth; and in the interval between the jaws it is attached to a band of fascia — the pterygo-maxillary ligament. From this origin the fibres are directed forwards to the angle of the mouth, where they mix with the other muscles and with both parts of the orbicularis; and as some of the central fibres descend to the lower lip whilst others ascend to the upper lip, a decussation takes place at the corner of the mouth. On the cutaneous surface of the buccinator are the different muscles that converge to the angle of the mouth; and crossing the upper part is the duct of the parotid gland, which perforates the muscle opposite the second upper molar tooth. Internally the muscle is lined by the mucous membrane of the mouth, and externally it is covered by a fascia that is continued to the pharynx. By its intermaxillary origin the buccinator corresponds to the attachment of the superior constrictor of the pharynx.

Buccinator muscle. Origin. Insertion at corners of the mouth. Parts in contact with it.

The VESSELS OF THE FACE consist of the facial and transverse facial arteries with their accompanying veins. The arteries are branches of the external carotid; and the facial vein is received into the internal jugular trunk.

Arteries of the face.

The *facial artery* emerges from the neck, and appears on the lower jaw, anterior to the masseter muscle. From this point the artery ascends in a tortuous manner, near the angle of the mouth and the side of the nose, to the inner angle of the orbit, where it anastomoses with the ophthalmic artery. The course of the vessel is comparatively superficial, though lying in the mass of fat of the inner part of the cheek. At first the artery is concealed by the platysma whilst crossing the jaw, but this thin muscle does not prevent pulsation being recognised during life; and near the mouth the large zygomatic muscle is superficial to it. The vessel rests successively on the lower jaw, buccinator muscle, elevator of the angle of the mouth, and elevator of the upper lip. Accompanying the artery is the facial vein, which is nearly a straight tube, and lies to its outer side.

Facial artery; course, and connections.

Branches. — From the outer side of the vessel unnamed

Plan of

the branches. branches are furnished to the muscles and integuments, some of which anastomose with the transverse facial artery. From the inner side are given the following branches: —

Inferior labial. 1. The *inferior labial branch* runs inwards beneath the depressor anguli oris muscle, and is distributed between the lower lip and chin; it communicates with the inferior coronary, and with the labial branch of the inferior dental artery.

Two coronary form an arch in the lip. Branch to nose. 2. *Coronary branches.*— There is one for each lip (superior and inferior), which arise together or separately from the facial, and are directed inwards between the orbicular muscle and the mucous membrane of the lip, till they inosculate with the corresponding branches of the opposite side. From the arterial arches thus formed, offsets are supplied to the lips and labial glands. From the arch in the upper lip a branch is given to the septum of the nose, — *artery of the septum.*

Lateral nasal branch. 3. The *lateral nasal branch* arises opposite the ala of the nose, and passes beneath the levator labii superioris alæque nasi, to be distributed on the side of the nose, where it anastomoses with the nasal branch of the ophthalmic artery.

Angular branch. 4. The *angular branch* is the terminal twig of the facial artery at the inner angle of the orbit, and joins with a branch of the ophthalmic artery.

Facial vein is away from artery; The *facial vein* commences at the root of the nose by a small vein named angular (p. 7.). It then crosses over the elevator of the upper lip, and separating from the artery courses beneath the large zygomatic muscle to the side of the jaw. Afterwards it has a short course in the neck to join the internal jugular vein.

is joined by some branches. *Branches.*— At the inner side of the orbit it receives veins from the lower eyelid (inferior palpebral) and the side of the nose. Below the orbit it is joined by the infra-orbital vein, also by a large branch that comes from the pterygoid region (anterior internal maxillary); and thence to its termination by veins corresponding to the branches of the artery both in the face and neck.

Transverse facial artery. The *transverse facial* is a branch of the temporal artery, and appears in the face at the anterior border of the parotid gland. It lies by the side of the parotid duct, with branches of the facial nerve, and distributes offsets to the muscles and integuments; some branches anastomose with the facial artery.

Lay bare the parotid. *Dissection.* — The parotid gland may next be displayed. To see the gland, raise the skin from its surface towards the

ear by means of a cut from the base of the jaw to the anterior border of the sterno-mastoid muscle; this cut may be united with that made for the dissection of the posterior muscle of the ear. A strong fascia covers the gland, and is connected above and behind to the zygoma and the cartilage of the ear, but in front is continued over the face. After the fascia has been removed, the superficial connections of the gland will appear. The great auricular nerve will be also seen ascending to the lobe of the ear.

The PAROTID is the largest of the salivary glands; it occupies the space between the ear and the lower jaw, and is named from its position. Its excretory duct enters the mouth through the middle of the cheek. Parotid gland.

The shape of the gland is irregular, and is determined somewhat by the bounding parts. Thus inferiorly, where there is not any resisting structure, the gland projects into the neck, and comes into close proximity with the sub-maxillary gland, though separated from it by a process of the cervical fascia; a line from the angle of the jaw to the sterno-mastoid muscle marks usually the extent of the parotid in this direction. Above, the parotid is limited by the zygoma and the temporal bone. At the posterior part the sterno-mastoid muscle extends; but anteriorly the gland projects somewhat on the face, and has a small accessory part, *socia parotidis*, prolonged from it over the masseter. Irregular in shape; is lodged between the jaw and ear; accessory part.

Connected with the anterior border is the excretory duct — duct of Stenson (*ductus Stenonis*), which crosses the masseter below the *socia parotidis*, and perforates the cheek obliquely opposite the second molar tooth of the upper jaw. The duct lies between the transverse facial artery and the branches of the facial nerve, the latter being below it. A line drawn from the meatus auditorius to a little below the nostril would mark the level of the duct in the face, and the central point of the line would be opposite the opening into the mouth. The length of the duct is about two inches and a half, and its capacity is about equal to a crow-quill, but the opening into the mouth is only large enough to allow a small probe to pass. The duct crosses side of face to reach mouth. Its length and size.

The cutaneous surface of the parotid is smooth, and has Cutane-

ous surface of gland. one or two lymphatic glands seated on it; but from the deep part processes are sent into the inequalities of the space between the jaw and the mastoid process.

Dissection to see deep parts. *Dissection.*—By removing with caution the parotid gland, the hollows that it fills up will come into view: at the same time the dissector will see the vessels and nerves that pass through the gland. An examination of the processes of the gland, and of the number of important vessels that are in relation with it, will demonstrate the impossibility of completely removing this body, and the dangers attending any operation on it. The duct may be now opened, and a probe passed along it to the mouth to show the diminished size of its aperture.

Deep part sinks behind jaw. Two large processes of the gland extend deeply into the neck. One dips behind the styloid process, and projects beneath the mastoid process and sterno-mastoid muscle, whilst it reaches also the deep vessels and nerves of the neck. The other piece is situate in front of the styloid process; it passes into the glenoid hollow behind the articulation of the lower jaw, and beneath the ramus of that bone along the internal maxillary artery.

Vessels and nerves in the gland. Passing through the middle of the gland is the external carotid artery, which ascends behind the ramus of the jaw, and furnishes the auricular, transverse facial, and superficial temporal and internal maxillary branches. Superficial to the artery is the trunk formed by the junction of the temporal and internal maxillary veins, from which the external jugular vein springs; and opening into this common trunk are some veins from the parotid, whilst a branch through the gland connects it with the internal jugular vein.* Crossing the gland from behind forwards is the trunk of the facial nerve, which passes over the artery, and distributes its branches through the parotid. The superficial temporal branch of the inferior maxillary nerve likewise lies above the upper part of the glandular mass; and offsets of the great

* Oftentimes a different arrangement of these veins will be found. In such case the external jugular is continued from the occipital (half or all) and posterior auricular veins. Whilst the temporal and internal maxillary veins unite to form a trunk (temporo-maxillary), that receives the facial below the jaw, and opens into the internal jugular vein opposite the upper border of the thyroid cartilage. When this condition exists, the temporo-maxillary trunk accompanies the external carotid artery.

auricular nerve pierce the gland at the lower part, and join the facial.

The *structure* of the parotid resembles that of the other salivary glands. The glandular mass is divided into numerous small lobules by intervening processes of fascia; and each lobule consists of a set of the closed saccular extremities of the excretory duct, surrounded by capillary vessels. The size of these little sacs, which by their aggregation form the mass of the lobule, is about $\frac{1}{1200}$ of an inch in diameter. The gland formed by termination of the ducts,

From the lobules issue small ducts, which unite to form larger tubes, and finally all the ducts of the gland are collected into one. An examination of the common duct (duct of Stenson) will show it to be composed of an external thick fibrous coat, and of an internal mucous coat which is covered with columnar epithelium. and the duct has two coats.

The parotid receives its arteries from the external carotid; and its nerves from the sympathetic, auriculo-temporal of the fifth, facial, and great auricular. Its lymphatics join those of the neck. Vessels and nerves.

Two or three small *molar* glands lie along the origin of the buccinator, and open into the mouth near the last molar tooth by separate ducts. Molar glands.

Cartilages of the Nose.—These close the anterior nasal aperture in the skeleton, and form part of the outer nose and the septum. They are five in number, two on each side — lateral cartilage and cartilage of the aperture; together with a central one, or the cartilage of the septum of the nose. Only the lateral cartilages are seen in this stage of the dissection. Nasal cartilages.

Dissection. — The lateral cartilages will be seen when all the muscular and fibrous structure of the left side of the nose, and the skin of the lower part of the nostril of the same side have been taken away. By passing the knife deeply in the middle line, the cartilage of the septum will be rendered apparent between the lateral cartilages of each side. Take away tissue from surface.

The *upper lateral cartilage* is flattened, and is somewhat triangular in form. Posteriorly it is attached to the nasal and superior maxillary bones; and anteriorly it meets the one of the opposite side for a short distance above, but the two are separated below by an interval, in which the cartilage of the septum appears. Inferiorly the lateral cartilage is contiguous to the cartilage of the aperture, and is connected to it by fibrous tissue. The upper cartilage touches its fellow in the middle.

The lower cartilage surrounds aperture. One part outside; The *cartilage of the aperture* forms nearly a ring around the nostril; for it is bent at an acute angle in front, and from this point a part extends backwards on both the outer and inner sides of that aperture. The *part* of the cartilage, that bounds the opening externally, does not reach downwards to the margin of the nostril, but ceases on a level with the groove on the outer aspect of the wing of the nose; it is narrow and pointed behind, but swells out in front and forms with its fellow the prominence of the apex of the nose. another inside nostril. The *inner part* projects backwards along the septum of the nose, nearly to the superior maxillary bone; it assists in the formation of the partition between the nostrils, and lies below the level of the septum nasi. Not inserted into bone. The cartilage of the aperture has not any attachment directly to bone; but it is united above to the lateral cartilage by fibrous tissue, and is connected below with the dense structure that forms the margin of the aperture of the nostril. At the tip of the nose the cartilages of opposite sides touch.

Accessory cartilages. Behind the outer half of the cartilage of the aperture, in the dense tissue that fixes it to the bone, are two or three small pieces of cartilage — *cartilagines minores* vel *sesamoideæ*, which seem to result from the breaking up of the hinder extremity of the cartilage of the aperture.

Appendages of the eye. The Appendages of the Eye consist of the eyebrow, the eyelid, and the lachrymal apparatus. Some of these can be seen now on the opposite side of the face; but the apparatus for the tears will be dissected after the orbit has been completed.

Eyebrow. The *eyebrow* (supercilium) is a curved eminence just above the eye, which corresponds to the orbital arch of the frontal bone. It consists of thickened integuments, and its prominence is also due to the subjacent orbicularis palpebrarum. It is furnished with long coarse hairs, that are directed outwards, and towards one another.

Eyelids. The *eyelids* are two semilunar folds in front of the eye, which are freely moveable, and can be approached over the eyeball, or can be separated so as partly to lay this bare. Upper the largest. The upper lid is the largest and the more moveable of the two, and descends below the middle of the eyeball when the two meet; it is also provided with a special muscle to raise it. The interval between the open lids is named *fissura*

palpebrarum. Externally and internally they are united by a commissure or *canthus.*

The free margin is thicker than the rest of the lid, and is semilunar in form for the greater part; but towards the inner side, or about a quarter of an inch from the commissure, it becomes straight. At the spot where these differently shaped parts join is a small white eminence, in which is the *punctum lachrymale*, or the opening of the canal for the tears. This margin is provided anteriorly with the eyelashes, and posteriorly with the openings of the Meibomian glands: but both the cilia and the Meibomian glands are absent from the part of the lid which is internal to the opening of the lachrymal canal.

Shape of margin.

Punctum.

Where hairs and apertures.

The *eyelashes* (cilia) are two or more rows of long hairs, which are fixed into the anterior edge of the free border of the lid; they are largest in the upper lid, and diminish in length from the centre towards the sides. The cilia are so arranged as to be convex towards one another.

Eye lashes.

STRUCTURE OF THE EYELIDS. — Each lid consists fundamentally of a piece of cartilage attached to the bones by ligaments. Superficial to this framework is the integument, with a layer of fibres of the orbicularis palpebrarum, and beneath it a mucous lining of the conjunctiva. The upper lid has also in it the tendon of the levator palpebræ. Vessels and nerves are furnished to these parts.

Different parts in eyelids.

Dissection. — The student may continue with the structure of the lids on the left side, on which the muscles are dissected. Let the bit of tow or wool remain beneath the lids, and let the palpebral part of the orbicularis palpebrarum be thrown inwards by means of an incision around the margin of the orbit. In raising the muscle, care must be taken of the palpebral ligament, and of the vessels and nerves of the lid.

Examine structure of lids.

Orbicularis palpebrarum. — The palpebral and ciliary fibres of this muscle form the thin pale layer that occupies the eyelids. A thin stratum of connective tissue, without fat, unites the muscle with the skin.

Layer of orbicularis.

The *palpebral ligament* is a stratum of fibrous membrane, that is continued from the margin of the orbit to join the lower free edge of the tarsal cartilage. At the inner part of the orbit the ligament is thin and loose, but at the outer part it is much thicker and stronger.

A fibrous layer.

Cartilage forms part of the lid.

The *tarsal cartilages*, one for each eyelid, give the form and strength to the lids, and are of the nature of yellow or spongy cartilage. Each is fixed internally by the *ligamentum* or *tendo palpebrarum*, and externally by a fibrous band — external *tarsal ligament* — to the outer part of the orbit. The margin corresponding to the edge of the lid is free, and thicker than the rest of the cartilage. On the inner surface each cartilage is lined by the mucous membrane or conjunctiva.

Difference in the two lids.

The cartilages are not alike in the two lids. In the upper eyelid, where the cartilage is largest, it is about half an inch wide in the centre, but gradually tapers to the ends; and to its fore part the tendon of the levator palpebræ is attached. In the lower lid the cartilage is a narrow band, about two lines broad, with borders nearly straight.

Ligament of eye-lids attaches cartilages.

Ligament or *tendon of the eyelids* (tendo palpebrarum, internal tarsal ligament) is a small fibrous band at the inner part of the orbit, which serves to fix the lids, and is attached to the anterior margin of the lachrymal groove. It is about a quarter of an inch long, and divides into two processes, which are united one with each tarsal cartilage. This ligament gives a fibrous expansion over the lachrymal sac, and the fleshy fibres of the orbicularis palpebrarum arise from it.

Follicular tubes beneath cartilage,

The *Meibomian glands* or follicles are placed in grooves on the ocular surface of the tarsal cartilages. They extend parallel to one another, from the thick towards the opposite margin of the cartilage; and their number is about thirty in the upper, and twenty in the lower lid. The apertures of the glands are at the posterior edge of the free border of the lid. Each gland is a small yellowish tube, closed at one end, and having minute lateral appendages connected with it. Each contains a sebaceous secretion, and is lined by scaly epithelium.

their structure.

Tendon of levator palpebræ.

If the palpebral ligament be cut through in the upper lid, the tendon of the levator palpebræ will be seen to be attached to all the fore part of the tarsal cartilage by a wide aponeurotic expansion.

Mucous lining of lid

The *conjunctiva*, or mucous membrane, lines the interior of the eyelids, where it has numerous fine papillæ, and covers the anterior part of the ball of the eye. At the free margin

of the lids this membrane joins the common integument; and it is further continued down the lachrymal canals and sac to the interior of the nose. At the inner commissure of the eyelids the conjunctiva forms a prominent, red, fleshy-looking body — *caruncula lachrymalis*, which encloses a group of mucous follicles, and has a few minute hairs on its surface. External to the caruncle is a small fold of the mucous membrane—*plica semilunaris;* this extends to the ball of the eye, and resembles the membrana nictitans of birds. forms caruncle and the contiguous fold.

Bloodvessels of the eyelids. — The *arteries* of the eyelids are furnished by the ophthalmic artery, and consist of the palpebral and lachrymal branches. Arteries of lids.

The *palpebral arteries*, one for each eyelid, run outwards from the inner canthus, lying between the orbicularis muscle and the tarsal cartilage, and anastomose externally with the lachrymal artery. From the arch that each forms, branches are distributed to the eyelids. The *lachrymal artery* perforates the palpebral ligament near the outer part of the orbit, and its offsets supply the lid, as well as anastomose with the palpebral branches. Palpebral and lachrymal.

The *veins* of the lids open into the frontal and angular veins at the root of the nose. Veins.

The *nerves of the eyelids* are supplied from the ophthalmic and facial nerves. Nerves of lids

The branches of the ophthalmic nerve (of the fifth) that give offsets to the upper lid, are the following: *lachrymal*, near the outer part; *supra-orbital*, about the middle; and *supra-trochlear* and *infra-trochlear* at the inner side (p. 45. 48.). In the lower eyelid, about its middle, is a *branch* of the *superior maxillary trunk* of the fifth nerve. The *branches* of the *facial nerve* enter both lids at the outer part, and supply the orbicularis muscle; they communicate with the branches of the fifth nerve. from fifth and seventh nerve.

EXTERNAL EAR. — The outer ear consists of a trumpet-shaped structure, named pinna or auricle, which collects sounds; and of a tube — meatus auditorius, which conveys those sounds to the inner ear. The pinna may be examined on the left side of the head, but the meatus will be described with the rest of the anatomy of the ear. Parts of external ear.

The *pinna*, or *auricle of the ear*, is an uneven piece of yellow cartilage, which is covered with integument, and is fixed to the margin of the meatus auditorius externus. It is Texture and form of pinna.

of an oval form, with the margin folded, and the larger end placed upwards.

Surfaces marked by fossæ and eminences. The surface next the head is convex, but the opposite one is hollowed out, and presents the undermentioned elevations and depressions. In the centre is a deep hollow named *concha*, which conducts to the meatus auditorius. In front of that hollow is a projection of a triangular shape — the *tragus*, which has some hairs on the under-surface; and on the opposite side of the hollow, rather below the level of the tragus, is another projection, — the *antitragus*. The round, rim-like margin of the ear is called the *helix*, and the depression internal to it, the groove, or fossa of the helix. Within the helix, between it and the concha, is the large eminence of the *antihelix*, which presents at the upper part a well-marked depression, the *fossa* of the antihelix. Inferiorly, the external ear is terminated by a soft, pendulous part, the *lobule*.

Five small muscles of external ear. The *muscles of the pinna*, which extend from one part of the cartilage to another, are very delicate, and in some bodies are not to be found. Five small muscles are usually described, which receive their names for the most part from the several eminences of the external ear.

How to find the small muscles. *Dissection.*—In seeking the following small muscles, let the integument be removed only over the spot where each muscle is said to be placed. A sharp knife and a good light are necessary for the display of the muscular fibres. Frequently the dissector will not find one or more of the set described below.

One muscle on tragus. The *muscle of the tragus* is always found on the external aspect of the process from which it takes its name. The fibres are short, nearly transverse, and extend from the outer to the inner part of the targus.

One to antitragus. The *muscle of the antitragus* is the best marked of all. It arises from the outer part of the antitragus, and the fibres are directed upwards to be inserted into the pointed extremity of the antihelix.

One on root of helix. The *small muscle of the helix* is often indistinct or absent. It is placed on the part of the rim of the ear that extends into the concha.

Another higher on helix. The *large muscle of the helix* arises above the small musele of the same part, and is inserted into the front of the helix, where this is about to curve backwards. It is usually present.

And one The *transverse muscle of the auricle* is found at the back of the

ear, in the depression between the antihelix and the convexity of the surface. It arises from the convexity of the cartilage that forms the concha, and is inserted into the back of the antihelix. The muscle is mixed with much fibrous tissue, but it is well seen when this is removed. muscle at back of concha.

Dissection.—The pinna may now be detached by cutting it as close as possible to the bone. When the integuments are entirely taken off, the cartilage of the pinna will be apparent; but in removing the integuments, the lobule of the ear, which consists only of skin and fat, will disappear. Clean the cartilage.

The *cartilage of the pinna* resembles much the external ear in form, and presents for notice nearly the same parts. The rim of the helix, however, subsides posteriorly in the antihelix about the middle of the pinna; whilst anteriorly a small piece projects from it, and a fissure will be found near that projection. The antihelix is divided posteriorly into two pieces; one of these is pointed, and is joined by the helix, the other is continued into the antitragus. Inferiorly the cartilage is fixed to the margin of the external auditory aperture in the temporal bone, and forms the outer part of the meatus auditorius, but it does not give rise to a complete tube, for the upper and posterior part of that canal is closed by fibrous tissue. On the posterior aspect of the concha is a strong vertical process of cartilage. Cartilage forms only part of external ear. Deficient inferiorly and at upper part of meatus.

In the piece of cartilage that forms the under-part of the meatus are two *fissures* (Santorini); one is at the base of the tragus, the other passes from before backwards. Its fissures.

Ligaments connect the pinna with the head, but others pass from one point of the cartilage to another. Ligaments:

The external ligaments are the condensed bands of fibrous tissue that extend between the same points as the external muscles (p. 2.), though commonly only an anterior and posterior are described. The chief special ligament crosses the interval between the tragus and the beginning of the helix, and completes the tube of the meatus. external; special.

The FACIAL NERVE (portio dura) is a part of the seventh cranial nerve, and confers motor power on the muscles of the face. Numerous communications take place between it and the fifth nerve, and the chief of these are found above and below the orbit, and over the side of the lower jaw. Outline of facial nerve.

Dissection of nerve

Dissection.—The facial nerve is to be displayed on the right side of the face if there is time sufficient before the body is turned (see p. 1.). Some of the nerve is concealed by the parotid gland, but the greater part is anterior to the glandular mass.

beyond parotid,

To expose the ramifications beyond the parotid gland, let the skin be raised from the face in the same manner as on the left side. The different branches of the nerve are then to be sought as they escape from beneath the anterior border of the gland, and to be followed forwards to their termination. The highest branches that go to the temple have been already partly dissected above the zygoma; and their junction with the temporal branch of the superior maxillary, and with the supra-orbital nerve has been seen. Other still smaller branches are to be traced to the outer part of the orbit, where they enter the eyelids and communicate with the other nerves in the lids; and by means of this set, whilst it crosses the malar bone, a junction is formed with the subcutaneous malar nerve of the fifth. With the duct of the parotid are two or more large branches, that are to be followed below the orbit to their junction with the infra-orbital, nasal, and infra-trochlear nerves. The remaining branches to the lower part of the face are smaller in size: one joins with the buccal nerve at the lower part of the buccinator muscle; and one or two others are to be traced forwards to the lower lip and to the labial branch of the inferior dental nerve.

and of the nerve in the parotid.

In order to trace backwards the trunk of the nerve through the gland, the integuments should be taken from the surface of the parotid as on the other side, and the gland removed piece by piece. In this proceeding the small branches of communication of the great auricular nerve with offsets of the facial, and the branches that dip down from the facial to the auriculo-temporal nerve are to be sought. Lastly, the tip of the mastoid process may be cut off with a chisel; and after turning it backwards with the sterno-mastoid muscle adhering to it, the small branches of the facial nerve to the back of the ear, and to the digastric and stylo-hyoid muscles, are to be looked for close to the base of the skull.

Branch-

THE NERVE OUTSIDE THE SKULL.—The nerve issues

from the stylo-mastoid foramen, after traversing the aqueduct of Fallopius, and furnishes immediately the three following small branches:— es outside the skull.

The *posterior auricular branch* turns upwards in front of the mastoid process, where it communicates with the great auricular, and with a branch to the ear from the pneumogastric (eighth) nerve, and ends in auricular and mastoid offsets (p. 8.). Posterior auricular branch.

The *branch to the digastric muscle* generally arises in common with the next. It is distributed by many offsets to the posterior belly of the muscle near the origin. Sometimes one of these offsets passes through the fleshy fibres, and descends to join the glosso-pharyngeal nerve. Branch to digastric.

The *branch to the stylo-hyoideus* is a long slender nerve, that is directed inwards to its muscle, which it enters about the middle. This branch communicates with the sympathetic nerve on the external carotid artery. Branch to stylo-hyoideus.

As soon as the facial nerve has given off those branches, it is directed forwards through the gland, and divides near the ramus of the jaw into two large trunks—temporo-facial and cervico-facial.

The TEMPORO-FACIAL TRUNK furnishes offsets to the side of the head and face, whose ramifications extend as low as the meatus auditorius. As this trunk crosses over the external carotid artery, it sends downwards branches to join the auriculo-temporal portion of the inferior maxillary nerve, and in front of the ear it gives some filaments to the tragus of the pinna. Three sets of branches, temporal, malar, and infra-orbital, are derived from the ending of the temporo-facial nerve. The upper trunk has three sets of branches.

The *temporal branches* ascend obliquely over the zygoma to the orbicular muscle, the corrugator supercilii, and the anterior part of the occipito-frontalis; in which they are united with offsets of the supra-orbital nerve. The attrahens aurem muscle is supplied by this set; and a junction takes place above the zygoma with the temporal branch of the superior maxillary nerve. Temporal branches pass to side of head.

The *malar branches* are directed to the outer angle of the orbit, and are distributed to the orbicularis muscle and the eyelids. In the eyelids communications take place with the palpebral filaments of the fifth nerve (p. 37.); and near the Malar branches go to eyelids.

outer part of the orbit, with the small subcutaneous malar branch of the superior maxillary nerve.

Infra-orbital branches are lost between eye and mouth.

The *infra-orbital branches* are larger than the rest, and are furnished to the muscles and the integument between the eye and mouth. Close to the orbit, and beneath the elevator of the upper lip, a remarkable communication,—*infra-orbital plexus*, is found between these nerves and the infra-orbital branches of the superior maxillary. After crossing the branches of the fifth nerve, some small offsets of the facial nerve pass inwards to the side of the nose, and others upwards to the inner angle of the orbit, to join the nasal and infra-trochlear branches of the ophthalmic nerve.

Lower trunk

also gives three sets of branches.

The CERVICO-FACIAL is smaller than the other trunk, and supplies nerves to the lower part of the face and to the upper part of the neck. Its highest branches join the lowest offsets of the temporo-facial nerve, and thus complete the network on the face. This trunk, whilst in the parotid, gives twigs to the gland, and is united with the great auricular nerve. The terminal branches that are distributed from it are, buccal, supra-maxillary, and infra-maxillary.

Buccal branches to corner of mouth.

The *buccal branches* pass forwards to the angle of the mouth, supplying the buccinator muscle, and they terminate in the orbicularis oris. On the buccinator they join the branch of the inferior maxillary nerve to that muscle.

Supra-maxillary between mouth and chin.

The *supra-maxillary branches* course inwards above the base of the lower jaw to the middle line of the chin, and supply the muscles and the integument between the chin and mouth. Beneath the depressor anguli oris the branches of the facial join offsets of the labial branch of the inferior dental nerve, in the same manner as the junction is made below the orbit; and the branches of the facial cross those of the fifth nerve in their course onwards to the middle line.

Infra-maxillary to neck.

The *infra-maxillary branches* are placed below the jaw, and are distributed to the upper part of the neck. The anatomy of these nerves will be given with the dissection of the anterior triangle of the neck (p. 62.).

Section IV.

DISSECTION OF THE ORBIT.

Directions.—The orbit should be dissected on that side on which the muscles of the face have been seen.

Position.—In the examination of the orbit, the head is placed in the same position as in the dissection of the sinuses of the base of the skull. Position of the body.

Dissection.—In order that the contents of the orbit may be seen, it will be necessary to take away the bones forming the roof of the space in the following manner:—Two cuts should be made with a saw through the margin of the orbit, one being placed at the outer, the other near the inner angle of the cavity; and these should be continued backwards with a chisel, along the roof of the orbit, nearly to the optic foramen. The piece of bone included in the incisions may now be tilted forwards, but is not to be taken away. Afterwards all the rest of the roof of the orbit is to be cut away with the bone forceps, except a ring of bone around the optic foramen; and any overhanging bone on the outer side, that may interfere with the dissection, may likewise be got rid of. The dissector should take care that all the wadding is removed from the eyelids, and that the eye is pulled gently forwards. The periosteum, detached from the bone, surrounds the contents of the orbital cavity. How to open the orbit.

The *periosteum* of the orbit is continuous with the dura mater of the brain through the sphenoidal fissure. It incases the contents of the orbit like a sac, and adheres but loosely to the bones. Apertures exist posteriorly in the membrane for the entrance of the different nerves and vessels; and on the sides prolongations of the membrane accompany the vessels and nerves that leave the cavity. Periosteum of orbit. Apertures in it.

Dissection. — The periosteum is next to be divided along the middle of the orbit, and to be cut away. After the removal of a little fat, the following nerves, vessels, and muscles come into view:— Open periosteum.

The frontal nerve and vessels lie in the centre, the lachrymal nerve and vessels close to the outer wall of the cavity; and the small fourth nerve at the back of the orbit: all these nerves enter the orbit above the muscles. The superior Position of parts in the cavity.

oblique muscle is recognised by the fourth nerve entering it: the levator palpebræ and superior rectus are beneath the frontal nerve; and the external rectus is partly seen below the lachrymal nerve. In the outer part of the orbit, near the front, is the lachrymal gland.

Trace superficial nerves.

The frontal and lachrymal nerves should be followed forwards to their exit from the orbit, and backwards with the fourth through the sphenoidal fissure to the wall of the cavernous sinus. In tracing them back, it will be expedient to remove the projecting clinoid process, should this still remain; and some care and trouble will be necessary to follow the lachrymal nerve to its commencement.

Take away some fat.

The muscles and vessels, refered to above, are to be cleaned, but it is not requisite to take all the fat from the orbit in this stage of the dissection.

In the orbit is eyeball, with seven muscles, several cranial nerves, their distribution; and some vessels.

Contents of the orbit.—Besides the eyeball and the lachrymal gland, there is a great quantity of granular fat in the orbit. Connected with the eye are six muscles — four straight and two oblique; and there is also an elevator of the upper eyelid in the cavity. The nerves in this small space are numerous, viz. the second, third, fourth, ophthalmic of the fifth, and the sixth nerve, together with the small orbital branch of the superior maxillary nerve; and their general distribution is as follows: — the second nerve enters the eyeball, the third is furnished to all the muscles but two, the fourth enters the superior oblique (one of the two excepted), and the sixth is spent in the external rectus muscle. The fifth nerve supplies some filaments to the eyeball, but the greater number of its branches pass through the orbital cavity to the face. The ophthalmic vessels are likewise contained in the orbit.

Lachrymal gland is at the outer part of orbit.

The *lachrymal gland* secretes the tears, and is situate in the hollow on the inner side of the external angular process of the frontal bone. It is of a lengthened form, something like an almond; and from its anterior part a thin piece projects beneath the upper eyelid. The upper surface is convex, and in contact with the periosteum, to which it is connected by fibrous bands that constitute a ligament for the gland; the lower surface rests on the eyeball and the external rectus muscle.

Its ducts

In *structure* the lachrymal resembles the salivary glands;

and its ducts, from six to eight in number, open by as many apertures in a semicircular line on the inner surface of the upper eyelid, near the outer canthus.

open on upper eyelid.

The FOURTH NERVE is the most internal of the three nerves that enter the orbit above the muscles. After reaching this space, it is directed inwards to the superior oblique muscle, which it enters at the orbital surface, contrary to the general mode of distribution of the nerves on the ocular surface of the muscles.

Fourth nerve supplies superior oblique.

The OPHTHALMIC NERVE of the fifth (p. 20.) as it approaches the sphenoidal fissure, furnishes from its inner side the nasal branch, and then terminates by dividing into the frontal and lachrymal branches; the former enters the orbit between the heads of the external rectus, but the other two lie, as before said, above the muscles.

Ophthalmic nerve gives three branches.

1. The *frontal nerve* is close to the outer side of the fourth as it enters the orbit, and is much larger than the lachrymal branch. In its course to the forehead the nerve lies along the middle of the orbit, and bifurcates anteriorly into the supra-trochlear and supra-orbital branches.

Frontal branch supplies the following.

The *supra-trochlear branch*, which is of small size, passes inwards towards the pulley of the superior oblique muscle, where it leaves the orbit to end in the eyelid and forehead (p. 7.). Before the nerve turns round the margin of the frontal bone, it sends downwards a branch of communication to the infra-trochlear branch of the nasal nerve. Frequently there are two supra-trochlear branches; in such instances one arises near the back of the orbit.

Branch above the pulley of oblique muscle; sometimes two:

The *supra-orbital branch* is the continuation of the frontal nerve in direction and size, and leaves the orbit by the supra-orbital notch. It then ascends on the forehead, and supplies the external part of the head (p. 7.). Whilst in the notch, the nerve gives downwards palpebral filaments to the upper lid.

and branch through orbital notch.

2. The *lachrymal nerve*, after entering the orbit in a separate tube of the dura mater, is directed forwards in the outer part of the cavity, and beneath the lachrymal gland, to the upper eyelid, where it pierces the palpebral ligament, and is distributed to the structures of the lid.

Lachrymal nerve ends in eyelid;

The nerve furnishes branches to the lachrymal gland; and near the gland it sends downwards one or two small filaments to communicate with the orbital branch of the superior maxillary nerve. Occasionally this nerve has a communicating filament with the fourth nerve.

its offsets join superior maxillary.

3. The *nasal nerve* is not visible at this stage of the dissection: it will be noticed afterwards at p. 47.

Dissection.

Dissection.— Divide the frontal nerve about its middle, and throw the ends forwards and backwards: by raising the posterior part of the nerve, the distinct origin of the nasal branch from the ophthalmic trunk will be seen. The lachrymal nerve may remain uncut.

Elevator of upper eyelid

The LEVATOR PALPEBRÆ SUPERIORIS is the most superficial muscle, and is *attached* posteriorly to the roof of the orbit in front of the optic foramen. The muscle widens as it extends forwards, and in front of the eyeball it turns downwards, and is *inserted* by a wide tendon into the fore part of the tarsal cartilage. By one surface the muscle is in contact with the frontal nerve and the periosteum; and by the other, with the superior rectus muscle. If it is cut across about the centre, a small branch of the third nerve will be seen entering the under surface.

is attached to tarsal cartilage; is highest muscle in orbit.

Upper rectus muscle. Origin. Insertion. Position to other parts.

The RECTUS SUPERIOR is the upper of the four muscles that lie around the globe of the eye. It *arises* from the upper part of the optic foramen, and is connected with the other recti muscles around the optic nerve. Near the front of the eye the fleshy fibres end in a tendon, which is *inserted*, like the other recti, into the sclerotic coat behind the union of this with the cornea. The under surface of the muscle is in contact with the globe of the eye, and some vessels and nerves to be afterwards seen; the other surface is covered by the preceding muscle.

Upper oblique muscle enters a loop. Insertion. Connections.

The SUPERIOR OBLIQUE MUSCLE is thin and narrow, and passes through a fibrous loop at the inner angle of the orbit, before reaching the eyeball. The muscle *arises* from the inner part of the optic foramen, and ends anteriorly in a rounded tendon, which, after passing through the loop before referred to, is reflected backwards and outwards between the superior rectus and the globe of the eye, and is *inserted* into the sclerotic coat behind the middle of the eyeball. The fourth nerve is supplied to the orbital surface of the muscle, and the nasal nerve lies below it. The thin insertion of the muscle lies between the superior and the external rectus, and near the tendon of the inferior oblique.

Pulley of the muscle.

The *loop*, or *pulley*, or *trochlea*, is a fibro-cartilaginous ring about two lines and a half in length, which is attached

by fibrous tissue to the depression of the frontal bone at the inner angle of the orbit. A fibrous prolongation is continued from the anterior margin of the pulley on the tendon as far as the eyeball; and a synovial membrane lines the ring, to facilitate the movement of the tendon through it. To see the synovial membrane and the tendon, this prolongation must be cut away.

Dissection.—The superior rectus muscle is next to be divided about the middle, and turned backwards, when a branch of the third nerve to its under surface will be found. The nasal nerve and the ophthalmic artery and vein will be now seen crossing inwards above the optic nerve: these should be traced forwards to the inner angle, and backwards to the posterior part of the orbit. By taking away some of the fat between the optic nerve and the external rectus, at the back of the orbit, the small lenticular ganglion and its branches will be discovered: the student will find the ciliary branches, that lie along the side of the optic nerve, the best guide to the situation of the ganglion. The dissector should then find the branches from the nasal and third nerves to the ganglion. And, lastly, he should separate from one another the nasal, third, and sixth nerves, as they enter the orbit between the heads of the external rectus muscle. Dissection. To find lenticular ganglion.

The THIRD NERVE is placed highest in the wall of the cavernous sinus; but at the sphenoidal fissure it descends below the fourth, and two branches (frontal and lachrymal) of the ophthalmic nerve. The nerve enters the orbit between the heads of the outer rectus, having previously divided into two parts. Third nerve as it enters orbit.

The *upper piece*, the smallest in size, ends in the under surface of the levator palpebræ and superior rectus muscles. Its upper branch.

The *lower part* supplies some of the other muscles, and will be dissected afterwards (p. 50.). Lower branch.

The *nasal branch* of the ophthalmic nerve enters the orbit between the heads of the rectus, and lies between the two parts of the third nerve. In the orbit the nerve is directed obliquely inwards, to reach the anterior of the two foramina in the inner wall. Passing through this aperture, the nerve appears in the cranium, at the outer margin of the cribriform plate of the ethmoid bone. Finally, it enters the nasal cavity by an aperture at the front of the cribriform plate: Nasal nerve. General course to the face.

and after passing behind the nasal bone, it is directed outwards between that bone and the cartilage, to end on the outer side of the nose.

In orbit. In the *orbit*, the nasal lies at first over the optic nerve, but beneath the superior rectus and levator palpebræ muscles, and afterwards below the superior oblique; in this part of its course it furnishes the following *branches*:—

Branches.

Long root of lenticular ganglion. The *branch to the lenticular ganglion* is about half an inch long and very slender, and arises as soon as the nerve enters the orbit: this is the long root of the lenticular ganglion.

Long ciliary branches. *Long ciliary branches.*— As the nasal crosses the optic nerve, it supplies two or more ciliary branches to the eyeball. These lie on the inner side of the optic, and join the ciliary branches of the lenticular ganglion.

Infra-trochlear branch. The *infra-trochlear branch* arises as the nasal nerve is about to leave the cavity, and is directed forwards below the pulley of the superior oblique muscle to the inner part of the orbit, where it ends in the upper eyelid, the conjunctiva, and the side of the nose. Before this branch leaves the orbit it receives an offset of communication from the supra-trochlear nerve.

In the nose. In the *nose.* Whilst in the nasal cavity the nerve furnishes branches to the lining membrane of both the septum narium and the outer wall: these will be subsequently referred to with the nose.

On the face. *Termination of the nasal nerve.*— After the nerve becomes cutaneous on the side of the nose, it descends beneath the compressor naris muscle, and ends in the integuments of the wing and tip of the nose.

Lenticular ganglion. The OPHTHALMIC OR LENTICULAR GANGLION is a small roundish body, of the size of a pin's head, and of a reddish colour. Situation. It is placed at the back of the orbit, between the optic nerve and the external rectus, and commonly on the outer side of the ophthalmic artery. Connections. By its posterior part the ganglion has branches of communication with other nerves (its roots); and from the anterior part proceed the ciliary nerves to the eyeball. Structure. In the ganglion, sensory, motory, and sympathetic filaments are combined.

Three roots: long, The *offsets of communication* are three in number. One, the *long root*, is the branch of the nasal nerve before noticed, which joins the superior angle. A second branch of considerable thickness short, (*short root*) passes from the inferior angle to join the branch of the third nerve that supplies the inferior oblique muscle. And

the third *root* is derived from the sympathetic (the cavernous plexus), either as a distinct branch to the posterior border of the ganglion or in union with the long root. and sympathetic.

Branches.— The short *ciliary nerves* are ten or twelve in number, and are collected into two bundles, which leave the upper and lower parts (superior and inferior angles) of the ganglion. In the upper bundle are four or five, and in the lower, six or seven nerves. As they extend along the optic nerve to the eyeball they occupy the outer and under parts, and communicate with the long ciliary branches of the nasal nerve. Ciliary branches to eyeball.

The OPHTHALMIC ARTERY is a branch of the internal carotid, and enters the orbit through the optic foramen. At first the vessel is outside the nerve, but it then courses inwards, over or under the nerve, to the inner angle of the orbit, where it ends in terminal branches. Ophthalmic artery in orbit.

The *branches* of the artery are numerous, though inconsiderable in size, and they are sometimes arranged in three sets: — one being outside the optic nerve, another above it, and a third set on its inner side. Branches.

a. The *lachrymal branch* accompanies the nerve of the same name to the upper eyelid, where it ends by supplying that part, and anastomosing with the palpebral arches. It supplies branches, like the nerve, to the lachrymal gland and the conjunctiva; and it anastomoses with the middle meningeal and deep temporal arteries, by offsets through the sphenoidal fissure and the outer wall of the orbit. Lachrymal branch supplies gland.

b. The *central artery of the retina* is a very small branch that enters the optic nerve, and so reaches its destination in the eyeball. Branch to the retina.

c. The *supra-orbital branch* arises beneath the levator palpebræ and superior rectus muscles; it then takes the course of the nerve of the same name through the notch in the margin of the orbit, and ends in branches on the forehead (p. 6.). As it winds round the margin of the orbit it supplies the eyelid and the orbicularis muscle. Supra-orbital branch.

d. The *ciliary branches* are uncertain in their place of origin, and enter the eyeball at both the front and back. The *posterior ciliary* are furnished from the ophthalmic trunk, or some of its branches. About twelve in number, they are continued to the eyeball around the optic nerve, and perforate the sclerotic coat at the posterior part. Two of this set (one on each side of the optic nerve) are named *long* ciliary; they pierce the sclerotic farther out than the others, and are then placed along the middle of the eyeball. The *anterior ciliary* arteries arise from muscular branches of the Ciliary arteries are posterior— two named long ciliary; and

anterior ciliary. ophthalmic, and pierce the sclerotic coat near the cornea: in the eyeball they anastomose with the posterior ciliary. See the dissection of the eyeball for the ending of these vessels.

Muscular. *e.* The *muscular branches* are furnished from the artery in its course, and those to the lower muscles often arise together.

Ethmoidal branches. Posterior and anterior. *f.* The *ethmoidal branches* are two, anterior and posterior, which pass through the two foramina in the inner wall of the orbit. The *posterior* is the smaller of the two, and furnishes small meningeal offsets (anterior) to the dura mater of the base of the skull. The *anterior* branch accompanies the nasal nerve, and gives likewise small meningeal offsets to the dura mater. Both send branches to the nose through the apertures in the cribriform plate of the ethmoid bone.

Branches to eyelids. *g.* The *palpebral branches*, one for each eyelid, generally arise together opposite the pulley of the superior oblique muscle, and then separate from one another. The arches they form have been dissected with the eyelids (p. 37.).

h. The *nasal* is one of the last branches of the ophthalmic, and is distributed to the side of the nose, on which it anastomoses with the nasal and angular branches of the facial artery.

i. The *frontal branch* turns round the margin of the orbit, and is distributed on the forehead (p. 6.).

Ophthalmic vein ends in cavernous sinus. The *ophthalmic vein* corresponds in its course and most of its branches to the artery of the same name. It begins at the inner angle of the orbit, where it joins the facial vein, and receives tributary branches in its progress to the back of the cavity. Posteriorly, it leaves the artery, and escapes from the orbit by the sphenoidal fissure, between the heads of the external rectus. It ends in the cavernous sinus.

Optic nerve ends in retina. The OPTIC NERVE can now be seen to extend from the optic foramen to the back of the eyeball. As the nerve enters the foramen, it is surrounded by the recti muscles; and beyond that spot, as far as the eyeball, the ciliary arteries and nerves entwine around it. It terminates in the retinal expansion of the eye.

Dissection. *Dissection.*—Take away the ophthalmic artery, and divide the optic nerve about its middle, together with the small ciliary vessels and nerves. Turn forwards the eyeball, and fasten it in that position with hooks. On removing some fat, the three recti muscles — inner, outer, and inferior; and the lower branch of the third nerve will appear.

Lower The *lower branch of the third nerve* supplies three muscles

in the orbit. Whilst entering this space between the heads of the external rectus, it lies below the nasal, and rather above the sixth nerve. Almost immediately afterwards the nerve divides into three branches. One of these enters the internal rectus; another the inferior rectus; and the third, the longest and most external branch, is continued forwards to the inferior oblique muscle. Soon after its origin the last nerve communicates with the lenticular ganglion, forming the short root of that body, and furnishes two or more filaments to the inferior rectus.

branch of third nerve is muscular,

and joins lenticular ganglion.

The SIXTH NERVE enters the orbit between the heads of the external rectus, below the other nerves in that interval, and above the ophthalmic vein. In the orbit it is distributed to the external rectus muscle.

Sixth nerve enters external rectus.

RECTI MUSCLES. — The *internal*, *inferior*, and *external rectus* muscles are placed with reference to the eyeball as their names express. They *arise* posteriorly from the circumference of the optic foramen by a common attachment, that partly surrounds the optic nerve. But the external rectus differs from the others in having two heads; an upper which joins the superior rectus; and a lower and larger one that blends with the inferior rectus, and is attached to a bony point on the lower border of the sphenoidal fissure, near to the inner end: some muscular fibres are also connected with a tendinous band between the heads. The muscles are directed forwards, and have a tendinous *insertion* into the ball of the eye, about a quarter of an inch from the cornea. Between the heads of origin of the external rectus, the different nerves before mentioned enter the orbit, viz. the third, the nasal branch of the fifth, and the sixth, together with the ophthalmic vein.

Straight muscles of eyeball. Origin.

Insertion.

Dissection. — By opening the optic foramen, the attachment of the recti muscles will be more fully seen. To dissect out the inferior oblique muscle, let the eyeball be replaced in its natural position; then by taking away the conjunctival lining of the lower eyelid near the inner part, and removing some fat, the muscle will appear beneath the eyeball, bending from the inner to the outer side.

Dissect inferior oblique.

The INFERIOR OBLIQUE MUSCLE is situate near the anterior margin of the orbit, and differs from the other muscles in the circumstance of its course being directed across, instead

Lower oblique muscle.

Origin. of parallel to the axis of the orbit. It *arises* from the superior maxillary bone, between the margin of the orbit Course. and the groove for the lachrymal sac. From this spot the muscle passes outwards beneath the inferior rectus, and Insertion. between the eyeball and the external rectus, to be *inserted* into the sclerotic coat, between the last muscle and the superior rectus. The borders of the muscle look forwards and backwards, and the posterior receives the Connections. branch of the third nerve. The tendon of insertion is near that of the superior oblique muscle, but rather closer to the optic nerve.

Seek tensor tarsi. *Dissection.*—To expose the small tensor tarsi muscle, the palpebral ligament attaching the eyelids to the margin of the orbit must be cut through, where this has not been done; but the lids must be left connected at the inner commissure by means of the tendo palpebrarum. By looking to the posterior aspect of the tendinous band attaching the tarsal cartilages, after the lids have been placed across the nose, the pale fibres of the tensor tarsi will be seen.

Tensor tarsi muscle. The TENSOR TARSI MUSCLE *arises* from the ridge on the os unguis, and slightly from the bone behind the ridge. Its fibres are pale, and form a very small flat band, behind the ligamentum palpebrarum, which divides like that structure Insertion. into a slip for each eyelid. In each eyelid the slip lies on the lachrymal canal, and blends with the other muscular fibres at the free margin of the tarsal cartilage.

Trace offset of superior maxillary nerve. *Dissection.*—A small nerve, the orbital branch of the superior maxillary trunk, lies in the outer angle of the floor of the orbit, and will come into view by the removal of the eyeball and its muscles. This nerve is very soft and easily broken. Two branches, temporal and malar, are to be traced forwards from it: and a filament of the lachrymal nerve is to be followed to its junction with the former. The outer wall of the orbit may be cut away, bit by bit, to follow the temporal branch through to the surface of the head.

Orbital branch of superior maxillary nerve; The *orbital branch* of the *superior maxillary nerve* arises in the spheno-maxillary fossa, and enters the orbit by the fissure of the same name. At the back of the orbit the nerve divides into malar and temporal branches, which ramify in the face and the side of the head.

its malar *a.* The *malar branch* (r. subcutaneus malæ) is directed forwards

along the floor of the orbit, and through a foramen in the malar bone to the face. After emerging from its foramen, this branch supplies the orbicularis, and communicates with the facial nerve.

b. The *temporal branch* ascends on the outer wall of the orbit, either beneath the periosteum, or in a groove in the bone, and being joined by a filament from the lachrymal nerve, passes into the temporal fossa through a foramen in the malar bone. The nerve is then directed upwards between the temporal muscle and the bone, and perforates the temporal fascia near the orbit. Its distribution has been seen in the examination of the cutaneous nerves of the head (p. 8.). and temporal branches.

LACHRYMAL APPARATUS.—The lachrymal gland and ducts, with the puncta, canals, and sac, constitute the apparatus by which the tears are formed and conveyed to the nose. The gland has been already described (see p. 44.). Apparatus for the tears.

Dissection.— Some bristles should be introduced into the lachrymal canals through the puncta of the eyelids that still remain in their natural place. The lachrymal sac will appear by removing the tensor tarsi and the connective tissue from its surface, as it lies on the os unguis. The prolongation from the tendo palpebrarum over the sac should likewise be prepared. Dissection.

The *puncta lachrymalia* are two small apertures, one for each lid, by which the tears enter the lachrymal canals. Each is situate in the free margin of the lid, about a quarter of an inch from the inner canthus, and in the elevation of the papilla lachrymalis. Apertures in eyelids.

The *lachrymal canals* are two small tubes that reach from the puncta, and convey the tears to the lachrymal sac; their situation is marked by the bristles that have been inserted in them. In their course inwards, the canals lie along the tendo-palpebrarum, one above and the other below it, and they are somewhat arched with the concavity towards the tendon. Internally, they open near together into the lachrymal sac rather above its middle. The canal in the upper eyelid is longer and more arched than that in the lower lid. Canals for the tears. Difference in the two lids.

The *lachrymal sac* and *duct* extend from the inner part of the orbit to the nose, and convey the tears into the latter cavity. They form one tube, of which the upper dilated part is the sac, and the lower constricted end the duct. Receptacle of the tears.

Situation of the sac, or dilated part.

The *sac* is situate in the hollow formed by the os unguis and nasal process of the superior maxillary bone. Externally, it is crossed by the ligament or tendon of the eyelids, and is covered by an expansion, derived from that tendon, which is fixed to the margins of the bony groove. If the aponeurotic covering be removed, the mucous membrane lining the interior will be seen. Into the outer side of the sac the lachrymal canals open.

Canal leading to the nose.

The *duct* (ductus ad nasum) is the narrowed part of the tube, that reaches to the nose. It is entirely encased by bone; and in length, size, and direction, it corresponds with the passage of the same name in the dried skull. In the nasal cavity it opens into the front of the inferior meatus, and a bent probe introduced through the nostril may be readily passed into it from that meatus.

Anatomy of eyeball afterwards.

The examination of the eyeball must be made on the fresh eye of either the ox or the sheep; but this part may be omitted with more advantage to the student till the dissection of the head and neck has been completed. The eyeball is described at the end of the book.

Section V.

DISSECTION OF THE NECK.

Position of the part.

Position. — For the dissection of the right side of the neck let the head be supported at a moderate height, and let the face be turned to the left side, and fastened in that position with hooks. To obtain a good view of the neck, the right arm should be drawn under the body, so that the point of the shoulder may be depressed, and the parts put on the stretch.

Boundaries of the side of neck.

Surface-marking.—The side of the neck presents a somewhat square outline, and is limited in the following way: — Inferiorly is the prominence of the clavicle, and superiorly is the base of the lower jaw with the skull. In front its boundary is marked by a line from the chin to the sternum, and behind, by another line from the occiput to the acromial end of the clavicle. The part thus marked out is divided into two triangular spaces (anterior and posterior) by the diagonal position of the sterno-mastoid muscle. In

Division into two triangles by sterno mastoid.

consequence of the direction of that muscle the base of the anterior space is at the jaw, and the apex at the sternum, whilst the base of the posterior one is at the clavicle, and the apex at the head. The surface in front of the sterno-mastoid is depressed at the upper part of the neck, near the position of the carotid vessels; and behind the muscle, near the clavicle, is another slight hollow, which points to the situation of the subclavian artery.

Along the middle line of the neck the following parts can be recognised through the skin: — About two inches and a half from the base of the jaw is the eminence of the os hyoides, with its cornu extending laterally on each side. Below this may be felt the wide prominence of the thyroid cartilage, called pomum Adami, which is most marked in the man; and between the cartilage and the hyoid bone is a slight interval corresponding to the thyro-hyoid membrane. Inferior to the thyroid, is the narrow prominent ring of the cricoid cartilage; and between the two the finger may distinguish another interval, which is opposite the crico-thyroid membrane. From this spot to the sternum, and between the sterno-mastoid muscles, is a depression, whose depth is much increased in emaciated persons, in which the tube of the trachea can be felt. In some bodies, especially in women, the swelling of the thyroid gland may be perceived by the side of the upper part of the trachea.

Prominences in the middle line of neck,

and suprasternal depression.

Direction. — As the time will not allow now the examination of the whole side of the neck, the student should lay bare in this stage only the parts behind the sterno-mastoid muscle.

Dissection. — To raise the integuments from the posterior triangle of the neck, and from the structures immediately connected with it, the skin may be divided along the sterno-mastoid from the one end to the other, and afterwards along the clavicle as far as the acromion. The triangular flap of skin is to be reflected from before back towards the trapezius muscle. The superficial fascia, which will then be brought into view, contains the platysma; and to see that muscle, it will be necessary to take the subcutaneous fat from its surface.

Dissection of the platysma.

The PLATYSMA MYOIDES is a thin subcutaneous muscular layer, which is now seen only in its lower half. The muscle is placed across the side of the neck, and extends

Platysma muscle.

arises at shoulder; from the top of the shoulder to the face. Its fibres take *origin* from the clavicle and the acromion, and below these bones from the fascia covering the pectoral and deltoid muscles; and then ascend over the side of the neck, to be inserted into jaw; *inserted* into the jaw. The lower part of the muscle is more closely united to the skin than the upper, and covers the external jugular vein as well as the lower part of the covers triangle. posterior triangle. At first the fibres of the muscle are thin and scattered, but they increase in strength as they ascend. The oblique direction of the fibres should be noted, because in venesection in the external jugular vein the incision is to be so made as to divide them across.

Dissection. *Dissection.*—The platysma is now to be cut across near the clavicle, and to be reflected upwards as far as the incision over the sterno-mastoid muscle, but it is here to be left attached. In raising the muscle the student must be careful of the deep fascia of the neck; and should dissect out the external jugular vein, and the superficial descending branches of the cervical plexus, which are close beneath it.

External jugular vein The *external jugular vein* commences in the parotid gland (p. 32.), and is directed backwards between the platysma and the deep fascia to the lower part of the neck, where it pierces the fascia to open into the subclavian vein. crosses side of neck to subclavian. Its course down the neck will be marked by a line from the angle of the jaw to the middle of the clavicle. The part of the vein now seen is joined by small superficial branches, and an offset connects it with the anterior jugular vein. Its size, and the height at which it crosses the sterno-mastoid muscle, are very uncertain.

Cervical fascia. The *deep cervical fascia* consists, like the aponeuroses in other regions of the body, of a superficial layer that surrounds the part continuously, and of processes that are prolonged inwards between the muscles. In some bodies this fascia is thin and indistinct. In its extent round the neck the membrane incases the sterno-mastoideus, and presents a Part behind sterno-mastoid muscle. different disposition before and behind that muscle. As now seen passing backwards from the muscle, the fascia continues over the posterior triangular space, and then encloses the trapezius, in its progress to the spines of the vertebræ. At the lower part of the neck the fascia is attached to the clavicle, and is perforated by the external jugular vein, and

the cutaneous nerves. After the superficial layer has been removed near the clavicle, a deep process may be observed to envelop the small omo-hyoid muscle, and to extend under the clavicle, where it is fixed to the back of that bone, and to the inner end of the first rib. sends a process beneath clavicle.

Dissection.—By the removal of the cervical fascia and the fat from the space between the sterno-mastoid and trapezius muscles, the posterior triangle of the neck will come into view. Crossing the space obliquely about an inch above the clavicle, and thus dividing it into two, is the small omo-hyoid muscle. Dissection of triangular space.

Above the omo-hyoid muscle will be found the ramifications of the branches of the cervical plexus, together with the spinal accessory nerve; the latter will be recognised by its piercing the sterno-mastoid muscle: the greater number of the branches of the cervical plexus descend to the shoulder, but the small occipital and great auricular nerves ascend to the head, whilst the superficial cervical branch is directed forwards over the sterno-mastoid muscle. Nerves above omo-hyoid;

Below the omo-hyoideus are the subclavian artery and the brachial plexus, which have a deep position. In this part also the following vessels and nerve are to be sought, viz. the supra-scapular vessels behind the clavicle; the transverse cervical vessels beneath the omo-hyoid muscle; and, lastly, the small branch of nerve to the subclavian muscle, which lies about the middle of the space between the clavicle and the omo-hyoideus. vessels below, in triangular space.

POSTERIOR TRIANGULAR SPACE.

This space, having the form and position before noted, is about eight inches in length, and contains the cervical and brachial plexuses, the portion of the subclavian artery on which a ligature is usually placed, together with other smaller vessels and some offsets of the nerves. It is bounded in front by the sterno-mastoid muscle, and behind by the trapezius. Its base corresponds to the middle third of the clavicle, and its apex is at the skull. In the area of the space are several muscles, which are to be recognised in the following order from above down, viz., splenius capitis, levator anguli scapulæ, and middle and posterior scalenus; and at the lower and outer angle, somewhat beneath the Posterior triangular space of the neck. Boundaries.

trapezius, is the upper part of the serratus magnus. Covering the space, are the structures already examined, viz. the skin and superficial fascia, the platysma over the lower half or more, and the deep fascia. The small omo-hyoid muscle crosses the lower part of the space, so as to subdivide it into two,—a lower or clavicular, and an upper or occipital.

is divided by omohyoideus.

Part near clavicle.

The *clavicular part* is small in size and close to the clavicle, and contains the subclavian artery. It is triangular in form, with its base directed forwards; and is bounded in front by the sterno-mastoid, above by the omo-hyoid muscle, and below by the clavicle. This small space measures commonly about one inch and a half from before backwards, and somewhat less in front at its base.

Vessels and nerves in this part, and their relative position

Crossing the area of this part of the space, rather above the level of the clavicle, is the trunk of the subclavian artery (the third part), which issues from beneath the anterior scalenus muscle, and is directed over the first rib to the axilla. Above the artery are the large cords of the brachial plexus, which accompany the vessel, and become closely applied to it beneath the clavicle. Beneath the artery and the nerves are the middle scalenus muscle and the first rib. Along the clavicular side of the space, and rather beneath the clavicle, are the supra-scapular vessels; and crossing the upper angle, at the meeting of the omo-hyoid and sterno-mastoid muscles, are the transverse cervical vessels. Entering the space from above is the external jugular vein, which descends over or under the omo-hyoideus near the anterior part, and opens into the subclavian vein; in this spot the vein receives the supra-scapular and transverse cervical branches, and sometimes a small vein, over the clavicle, from the cephalic vein of the arm.

Variations in the size of the space; also in the depth,

The size of the clavicular part of the posterior triangular space is influenced by the extent of the attachment of the trapezius and sterno-mastoid muscles along the clavicle, since in some bodies these muscles occupy nearly the whole length of the bone. The space may be farther increased or diminished by the position of the omo-hyoideus in the neck; for this muscle may lie close to the clavicle, being attached thereto, or it may be distant one inch and a half from that bone. In depth the space varies naturally; and in a short thick neck, with a prominent clavicle, the artery is farther

from the surface than in the opposite condition of the parts. But the depth is altered much more by the position of the clavicle, according as the limb is raised or depressed; for the arm and shoulder may be carried upwards until the collar bone rises above the level of the omo-hyoid muscle, and entirely conceals the artery in its usual position. both natural and artificial.

The situation of the trunk of the subclavian artery may vary much, for it may be one inch and a half above the clavicle, or at any point intermediate between this and its usual level, just above the prominence of that bone. Further, its position to the anterior scalenus may be altered; and instead of the vessel being beneath, it may be in front of, or even between the fibres of that muscle. Commonly there is not any branch connected with the artery in this part of its course; but the posterior scapular branch may take origin from it at different distances from the scalenus, or there may be more than one branch (Quain). In the ordinary disposition of the vessels the subclavian vein is not seen, owing to its situation being lower down, beneath the clavicle; but it not unfrequently rises upwards as high as the artery, or it may even lie with the artery beneath the anterior scalenus in some rare instances. The position of the external jugular vein with regard to the subclavian artery is very uncertain, and the branches connected with its lower end may form a kind of plexus over the arterial trunk. Departure from the ordinary state of the vessels.

The *occipital part* of the posterior triangular space is of larger extent than the other. Its boundaries in front and behind are the sterno-mastoid and the trapezius, and it is separated from the clavicular portion by the omo-hyoid muscle. In it are contained chiefly the ramifications of the cervical plexus; and a chain of lymphatic glands lies along the sterno-mastoid muscle. Beneath the spinal nerves is the middle scalenus, and still farther behind are some muscles of the back before seen. The spinal accessory nerve is directed obliquely across this interval from the sterno-mastoid muscle, which it pierces, to the under-surface of the trapezius; and a communication takes place between this cranial nerve and the spinal nerves in the triangular space. Part of triangular space near the head contains nerves and lymphatics; also spinal accessory nerve.

Superficial Branches of the Cervical Plexus. — Behind the sterno-mastoid muscle appear some of the rami- Nerves of the cervical

plexus fications of the cervical nerves in the plexus of the same name, and superficial branches are furnished from these both upwards and downwards.

that ascend, viz. A. The ASCENDING SET are three in number, viz. small occipital, great auricular, and superficial cervical.

Small occipital. 1. The *small occipital branch* comes from the second cervical nerve, and is directed upwards to the head along the posterior border of the sterno-mastoid muscle. At first the nerve is beneath the fascia; but near the occiput it becomes cutaneous, and is distributed between the ear and the great occipital nerve (p. 9.). Occasionally there is a second cutaneous nerve to the head.

Great auricular. 2. The *great auricular nerve* is a branch of that part of the plexus which is formed by the second and third cervical nerves. Perforating the deep fascia at the posterior border of the sterno-mastoid muscle, the nerve is then directed upwards beneath the platysma to the lobule of the ear, where it ends in the following branches:—

supplies facial, The *facial branches* are sent forwards to the integument over the parotid, and a few slender filaments pass through the gland to join the facial nerve.

auricular: The *auricular branches* ascend to the external ear, and are chiefly distributed on its cranial aspect; one or more reach the opposite surface by piercing the pinna. On the ear they communicate with the branches furnished from the facial and pneumogastric nerves.

and mastoid branches. The *mastoid branch* is directed backwards to the integument between the ear and the mastoid process; and it joins the posterior auricular branch of the facial nerve (p. 8.).

Superficial cervical nerve. 3. The *superficial cervical nerve* springs from the same source as the preceding, and turns forwards round the sterno-mastoid muscle about the middle. Afterwards it pierces the fascia, and ramifies over the anterior triangular space beneath the platysma myoides (see p. 62.). There may be more than one branch to represent this nerve.

Nerves that descend are B. The DESCENDING SET of branches (supra-clavicular) are derived from the third and fourth nerves of the plexus, and are directed towards the clavicle over the lower part of the posterior triangular space. Their number is somewhat uncertain, but usually there are about three on the clavicle.

sternal, supra-clavicu- The most internal branch (sternal) crosses the clavicle near its inner end; the middle branch lies about the middle

of that bone; and the posterior (acromial) turns over the attachment of the trapezius to the acromion. All are distributed to the integuments of the chest and shoulder. *lar, and acromial.*

Lymphatic glands of neck. The *lymphatic glands* (glandulæ concatenatæ) that lie along the sterno-mastoid muscle, are continuous at the lower part of the neck with the glands in the cavity of the thorax. There is also a superficial chain along the external jugular vein.

Dissection. *Dissection.*—The dissection of the posterior triangle should be repeated on the left side of the neck, in order that the difference in the vessels may be observed. Afterwards the reflected parts are to be replaced and carefully fastened in their natural position with a few stitches, preservative fluid having been previously applied with strips of calico.

The back to be examined now. *Directions.*—It is supposed that the body will now be turned on its fore part for the dissection of the back. During the period allotted for this position the student is to learn the posterior part of the neck. After the completion of the dissection of the back the student should take out the spinal cord, and then return to the examination of the front of the neck.

FRONT OF THE NECK.

Examine right side of neck. *Directions.*—When the body has been again turned, the dissector should continue with the remainder of the right side of the neck. The head and neck may be detached from the trunk, supposing the thorax to be finished, by dividing the spinal column between the second and third dorsal vertebræ. By this step the student obtains the clavicles and the first ribs, and preserves the natural position of the parts at the root of the neck: he should moreover be careful to take the arch of the aorta.

Position of part. *Position.*—After the part has been detached, the face is to be turned to the left away from the dissector, and a small narrow block is to be placed beneath the neck; the neck is to be made tense by means of hooks, the chin being well raised at the same time.

Dissection. *Dissection.*—An incision along the base of the jaw will readily allow the piece of integument in front of the sterno-

mastoideus to be raised towards the middle line. Beneath the skin is the superficial fascia, containing the ramifications of the superficial cervical nerve. The nerve is to be followed forwards from its trunk, and the fat is to be taken away from the platysma muscle.

Platysma muscle in front of sterno-mastoid.

Platysma Myoides. — The anterior part of the platysma, viz. from the sterno-mastoid muscle to the lower jaw, covers the greater portion of the anterior triangular space. The fibres have the same appearance in this as in the lower half of the muscle, but they are rather stronger. At the base of the jaw they are inserted between the symphysis and the masseter muscle, while other and more posterior fibres are continued over the face, joining the depressor anguli oris and risorius, as far as the fascia covering the parotid gland, or the cheek bone. Below the chin the fibres of opposite muscles cross for the distance of about an inch, but those that are superficial do not belong always to the same side. This part of the muscle is superficial, and conceals the following nerves: —

Insertion into jaw.

Superficial cervical nerve:

The *superficial cervical nerve* has been traced from its origin in the cervical plexus to its position superficial to the fascia of the neck (p. 60.); and the nerve may arise from the plexus by two pieces. Beneath the platysma it divides into an ascending and a descending branch, and is distributed on the front of the neck.

branches to integuments and platysma of neck.

The *ascending branch* perforates the platysma, and ends in the integuments over the anterior triangle, about half way down the neck, as well as in the platysma. Whilst this branch is beneath the platysma it joins with the facial nerve.

The *descending branch* likewise passes through the platysma, and is distributed below the preceding, reaching as low as the sternum.

Dissection.

Dissection. — Raise the platysma to the base of the jaw, and dissect out the cervical branches of the facial nerve that are beneath it. Clean also the deep fascia of the neck.

Branches of facial nerve to the neck.

The *infra-maxillary branches of the facial* or *seventh cranial nerve* (rami subcutanei colli) (p. 42.) pierce the deep cervical fascia, and pass forwards beneath the platysma, forming arches across the side of the neck, which reach as low as the hyoid bone. Most of the branches end in the platysma, but a few filaments perforate it and supply the integument. Beneath the muscle there is a communication

established between these branches of the facial and the offsets of the superficial cervical nerve.

The part of the *deep cervical fascia* in front of the sterno-mastoideus is stronger than it is behind that muscle, and has the following disposition. Near the sternum the fascia forms a white firm membrane, which is attached to that bone; but higher in the neck it becomes thinner, and is fixed to the lower jaw and the zygoma, covering also the parotid gland. From the angle and ramus of the jaw a piece is prolonged downwards, between the parotid and sub-maxillary glands, to join the styloid process; this piece is named *stylo-maxillary ligament.* Intermuscular partitions are sent between the muscles; and the layer beneath the sterno-mastoid is connected with the sheath of the cervical vessels. One of these strata, viz. that beneath the sterno-thyroid muscle, descends in front of the great vessels at the root of the neck to the arch of the aorta and the pericardium.

Cervical fascia in front of sterno-mastoid

forms stylo-maxillary ligament and sheath of vessels.

Dissection. — To define the anterior triangular space, take away the deep fascia of the neck, and clean the surface of the hyoid muscles that appear along the middle line, dissecting out at the same time the anterior jugular vein.

Dissection of anterior triangle.

Next, the parts that occupy the anterior triangle are to be brought into view by taking away the fat and fascia, but without displacing or injuring them. In removing the sheath from the cervical vessels, as these appear from beneath the muscles at the lower part of the neck, the dissector should be careful of the small descending branch of the hypo-glossal nerve in front of it. In the sheath between the vessels (carotid artery and jugular vein) will be found the pneumo-gastric nerve, and behind the same, the sympathetic nerve. The trunks into which the artery bifurcates are to be followed upwards, especially the more superficial one (external carotid), whose numerous branches are to be traced as far as they lie in the space. Crossing the space, in the direction of a line from the mastoid process to the hyoid bone, are the digastric and stylo-hyoid muscles; and lying below them is the hypo-glossal nerve, which gives one branch (descendens noni) in front of the sheath, and another to the thyro-hyoid muscle. Directed downwards and backwards from beneath the same muscles to the sterno-mastoideus, is the spinal accessory nerve. On the

Seek a small nerve.

Trace arteries

and nerves.

Laryn-

geal nerves. inner side of the vessels, between the hyoid bone and the thyroid cartilage, the dissector will find the superior laryngeal nerve; and with the descending part of the superior thyroid artery, its small external laryngeal branch.

Clean gland, seek nerve to mylo-hyoid. Lastly, clean the submaxillary gland close to the base of the jaw; and on partly dislodging it from the surface of the mylo-hyoid muscle, the student will expose the small branch of nerve to that muscle with the submental artery. The interval between the jaw and the mastoid process is supposed to be cleaned by the removal of the parotid gland in the dissection of the facial nerve.

ANTERIOR TRIANGULAR SPACE.

Triangular space in front of neck. This space contains the carotid vessels and their branches, with many nerves, and corresponds with the hollow on the surface of the neck in front of the sterno-mastoid muscle. Boundaries. Its limits are the following: — behind is the sterno-mastoid muscle; and in front a line, from the chin to the sternum, along the middle of the neck. Above, at the base of the space, would be the lower jaw, with a line prolonged from it to the sterno-mastoideus; and below, at the apex, is the sternum. Over this space are placed the skin and superficial fascia, the platysma, the deep fascia, and the ramifications of the facial and superficial cervical nerves. In the area of the triangular interval, as it is above defined, are seen the larynx, and many muscles converging towards the hyoid bone as a centre, some being above and some below it. Below are the depressors of that bone, viz. omo-hyoid, sterno-hyoid, and sterno-thyroid; and above, the elevators of the bone, viz. mylo-hyoid, and digastric and stylo-hyoid. Connected with the back of the hyoid bone and the larynx are some of the constrictor muscles of the gullet.

Carotid artery in space. The carotid blood-vessels occupy the hinder and deeper part of the space along the side of the sterno-mastoid muscle, Course. and their course would be marked on the surface by a line from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. Coverings. As high as the level of the cricoid cartilage, the vessels are covered by the depressor muscles of the os hyoides; but beyond that they are concealed by the common coverings of the space, and by the sterno-mastoid muscle which, before the

parts are displaced, overhangs or conceals the vessels — in some bodies to a level with the hyoid bone, and in others as far as the parotid gland.

For a short distance after its exit from beneath the muscles at the root of the neck, the common carotid artery remains a single trunk, but opposite the upper border of the thyroid cartilage it divides into two large vessels, external and internal carotid. From the place of division these trunks are continued onwards, beneath the digastric and stylo-hyoid muscles, to the interval between the jaw and the mastoid process. At first the trunks lie side by side, the vessel destined for the internal parts of the head being the more posterior of the two, but above the digastric muscle one becomes superficial to the other. The more superficial artery (external carotid) furnishes many branches to the neck and the outer part of the head, viz. some forwards to the larynx, tongue, and face; others backwards to the occiput and ear; and others upwards to the head. The deeper trunk (internal carotid) ascends to the head without branching, and is distributed to the interior of the skull.

Bifurcation.

Position of two trunks to one another.

Branches.

But the common carotid does not always divide, as here said, for it sometimes ascends as an undivided trunk (though very rarely), furnishing offsets to the neck and head. Or the point of branching of the vessel may be moved from the upper border of the thyroid cartilage, either upwards or downwards, so that the trunk of the carotid may remain undivided till it is beyond the os hyoides, or end in branches opposite the cricoid cartilage. The division beyond the usual place is more frequent than the branching short of that spot. In close contact with the outer side of both the common trunk and the internal carotid artery, is the large internal jugular vein, which receives branches in the neck corresponding to some of the branches of the superficial artery; but in some cases the vein covers the artery, and the branches joining it above may form a kind of plexus over the upper part of the common arterial trunk.

Changes in the place of division of carotid.

Jugular vein

alters position.

In connection, more or less intimate, with the large vessels, are the following nerves: — in front of the sheath is the descending branch of the hypo-glossal nerve; within the sheath, between the carotid artery and jugular vein, is the pneumo-gastric nerve; and behind the sheath is the sympa-

Nerves in connection with the arteries.

thetic nerve. Crossing over the vessels, so as to form an arch below the digastric muscle, is the hypo-glossal nerve, which gives downwards its branch (descendens noni) most commonly in front of the sheath. Along the outer part of the vessels the spinal accessory nerve extends for a short distance, till it pierces the sterno-mastoid muscle. And on the inner side of the internal carotid artery, opposite the hyoid bone, the superior laryngeal nerve appears; whilst a little lower down, with the descending branches of the thyroid artery, is the external laryngeal branch of that nerve. Appearing also on the inner side of the two carotid arteries, close to the base of the space, is the glosso-pharyngeal nerve, which courses forwards between them.

Glands: submaxillary

Two glandular bodies, the submaxillary and thyroid, have their seat in this triangular space of the neck. Altogether in front of the vessels, and partly concealed by the jaw, is the submaxillary gland; and beneath it on the surface of the mylo-hyoideus is the small nerve to that muscle, with the submental artery. By the side of the thyroid cartilage, between it and the common carotid artery, is the thyroid body, which is covered by the sterno-thyroid muscle: in the female this body is much more strongly marked than in the male.

and thyroid body.

Parotid gland.

At the base of the space, if the parts were not disturbed, would be the parotid gland, which is wedged into the hollow between the jaw and the mastoid process, and projects somewhat below the level of the jaw. Its connections have been noticed at p. 31.

Direction.— The student has next to proceed with the examination of the individual parts that have been referred to in connection with the triangular spaces.

Anterior jugular vein

Anterior jugular vein.— This small vein occupies the middle line of the neck, and its size is dependent upon the degree of development of the external jugular. Beginning in some small branches below the chin, the vein descends to the sternum, and then turns outwards beneath the sterno-mastoid muscle, to open into the subclavian vein, or the external jugular. In the neck the anterior and external jugular veins communicate. There are two anterior veins, one for each side, though one is usually larger than the

joins subclavian vein.

other, and at the bottom of the neck they are joined by a transverse branch.

The STERNO-CLEIDO-MASTOID MUSCLE forms the superficial prominence of the side of the neck, and divides the lateral surface of the neck into two triangular spaces. The muscle is narrower in the centre than at the ends, and is attached below by two heads of origin, which are separated by an elongated interval. The inner head is fixed by a narrowed tendon to the anterior part of the first piece of the sternum, and the outer head has a wide attachment to the sternal third of the clavicle. From this origin the heads are directed upwards, the internal passing backwards and the external almost vertically, and are blended about the middle of the neck in a roundish muscle. Near the head the muscle ends in a tendon, which is then *inserted* into the base of the mastoid process at the outer aspect, and by a thin aponeurosis into a rough surface behind that process, as well as into the outer part of the upper curved line of the occipital bone. The borders of the muscle correspond to the triangular spaces of the neck, and the anterior one is the guide to the position of the common carotid artery. On its cutaneous surface the sterno-mastoid is covered by the common integuments and platysma, by the external jugular vein and superficial branches of the cervical plexus (across the middle part), and by the deep fascia. If the muscle be cut through below and raised, it will be seen to lie on the following parts:—the clavicular origin lies over the anterior scalenus and omo-hyoid muscles; and the sternal head conceals the depressors of the hyoid bone, and the common carotid artery with its vein and nerves. After the union of the heads, the muscle is placed over the cervical plexus, the middle scalenus, and the elevator of the angle of the scapula; and near the skull, on the digastric and splenius muscles, with the occipital artery, and a part of the parotid gland. The spinal accessory nerve perforates the muscular fibres about the upper third. The extent of the attachment to the clavicle varies, and in some bodies it may reach even to the trapezius.

Sterno-mastoid muscle has its origin at sternum, and clavicle, and insertion at skull. Guide to artery. Position to other parts.

The OMO-HYOID MUSCLE crosses beneath the sterno-mastoideus, and consists of two fleshy bellies united by a small round intermediate tendon. The *origin* of the muscle from

Omo-hyoid muscle begins at the sca-

pula, and ends at hyoid bone. the scapula, and the connections of the posterior part, are to be studied in the dissection of the back. From the intervening tendon, the anterior fleshy part is directed forwards along the border of the sterno-hyoid muscle, and is *inserted* into the lower part of the body of the hyoid bone, close to the great cornu. The anterior belly of the muscle is in contact with the fascia, after escaping from beneath the sterno-mastoid; and rests on the sterno-thyroid muscle. This muscle crosses the common carotid artery on a level with the cricoid cartilage.

Connections.

Sterno-hyoid muscle

The STERNO-HYOID MUSCLE is a flat thin band nearer the middle line than the preceding. It *arises* from the posterior aspect of the sternum and the cartilage of the first rib, and sometimes also from the clavicle. From this spot the fibres ascend, and are *inserted* into the lower border of the body of the os hyoides, internal to the preceding muscle. One surface is in contact with the fascia, and is often marked by a tendinous intersection near the clavicle. When the muscle is divided and turned aside, the deep surface will be found to rest on the sterno-thyroideus and its continuation (thyro-hyoid), also on the superior thyroid vessels. The muscles of opposite sides are separated by a cellular interval which is largest below. The origin of the muscle varies much.

named from its attachments.

Parts above and beneath.

Sterno-thyroid muscle is named from its attachments.

The STERNO-THYROID MUSCLE is wider and shorter than the sterno-hyoid, beneath which it lies. Like the other hyoid muscle, it *arises* from the posterior surface of the sternum, from the cartilage of the first rib below the former, and sometimes from the cartilage of the second rib; and is *inserted* into the oblique line on the side of the thyroid cartilage, where it is continuous with the thyro-hyoid muscle. The inner border corresponds to the middle line of the neck and to the thyroid veins, whilst the outer reaches the carotid artery. The superficial surface is concealed by the preceding hyoid muscles; and the opposite surface is in contact with the lower part of the carotid artery, the trachea, and the larynx and thyroid body. A transverse tendinous line crosses the muscle near the sternum.

Parts above and beneath.

Thyro-hyoid a continuation of preceding to os hyoides.

The THYRO-HYOIDEUS is a continuation of the last muscle. Beginning on the side of the thyroid cartilage, the fibres ascend to the inner half of the great cornu of the os hyoides, and to the outer part of the body of the bone. On the

muscle lie the omo-hyoideus and sterno-hyoideus; and beneath it are the superior laryngeal nerve and vessels. This is sometimes considered one of the special muscles of the larynx.

Direction. — The remaining parts included in this SECTION are the scaleni muscles and the subclavian blood-vessels, and the cervical nerves and the carotid blood-vessels. The student may examine these in the order here given.

Dissection. — Supposing the sterno-mastoid to be cut, the fat and fascia are to be taken away from the lower part of the neck, so as to prepare the scaleni muscles, with the subclavian vessels and their branches. By means of a little dissection the anterior scalenus muscle will be seen ascending from the first rib to the neck, having the phrenic nerve and subclavian vein in front of it, the latter being near the rib. The part of the subclavian artery that is on the inner side of the scalenus is then to be cleaned, care being taken not only of its branches, but of the branches of the sympathetic nerve which course from the neck to the chest. This dissection will be facilitated by the removal of a part or the whole of the clavicle. All the branches of the artery are in general easily found, except the superior intercostal, which is to be sought in the thorax in front of the neck of the first rib. On the branch (inferior thyroid) ascending to the thyroid body, or near it, is the middle cervical ganglion of the sympathetic, and the dissector should follow downwards from it the small nerves to the thorax. Only the origin and first part of the course of the vascular branches can now be seen; their termination is met with in other stages of this dissection, or in the dissection of other parts of the body. In this stage the student should seek the small right lymphatic duct that opens into the subclavian vein near its junction with the jugular. A notice of it will be given with the lymphatics of the thorax.

Dissection of the subclavian artery

and branches.

Of lymphatic duct.

The outer part of the subclavian artery having been already prepared, let the dissector remove more completely the connective tissue from the nerves of the cervical and brachial plexuses. From the brachial plexus trace the small subclavian branch; and the branches to the rhomboid and serratus muscles, which pierce the middle scalenus. If it

Of brachial plexus.

is thought necessary, the anterior scalenus may be cut through after the artery has been studied.

Of cervical plexus. From the cervical plexus, besides muscular branches, the student should seek small twigs to join the descendens noni; and should define the roots of the phrenic nerve. Lastly, let the surface of the middle scalenus muscle be cleaned, as it lies beneath the cervical nerves.

Number of scaleni muscles. The SCALENI muscles are usually described as three in number, and are named, from their relative position, anterior, middle, and posterior: they extend from the first two ribs to the transverse processes of certain cervical vertebræ.

Scalenus anticus. The SCALENUS ANTICUS extends from the first rib to the lower cervical vertebræ, and is somewhat conical in shape. Origin from first rib; It is attached by its apex to the inner border and the upper surface of the first rib, so as to surround the rough surface or projection on this aspect of the bone; and by its base it insertion; is *inserted* into the anterior transverse processes (parapophyses) of four of the cervical vertebræ, viz. sixth, fifth, connections with muscles, fourth, and third. More deeply seated below than above, the muscle is concealed by the clavicle and the subjacent muscle (subclavius), and by the clavicular part of the sterno-mastoid: the phrenic nerve lies along the cutaneous surface vessels, of the muscle, and the subclavian vein crosses over it near the rib. Along the inner border is the internal jugular and nerves. vein. Beneath the scalenus are the pleura, the subclavian artery, and the nerves of the brachial plexus. The insertion into the vertebræ corresponds to the origin of the rectus capitis anticus major muscle.

Scalenus medius. Origin. The SCALENUS MEDIUS MUSCLE is larger than the anterior, and extends farthest of all on the vertebræ. Inferiorly it is attached to the inner border of the first rib; and to a groove on the upper surface, which extends obliquely forwards for one inch and a half from the tubercle to the anterior border. Insertion. The muscle ascends behind the spinal nerves, and is *inserted* into the tips of the posterior transverse processes (diapophyses) of the six lower cervical vertebræ. Parts in contact with it. In contact with the anterior surface are the subclavian artery and the spinal nerves, together with the sterno-mastoid muscle; whilst the posterior surface touches the posterior scalenus, and the deep lateral muscles of the back of the neck. The

outer border is perforated by the nerves of the rhomboid and serratus muscles.

The SCALENUS POSTICUS is inconsiderable in size, and appears part of the preceding. It is attached below by a slip, about half an inch wide, to the upper border of the second rib, in front of the elevator of that bone; and above, it is inserted with the scalenus medius into two or three of the lower cervical vertebræ. Scalenus, posticus. Attachments.

The SUBCLAVIAN ARTERY is a given part of the large vessel that supplies the upper limb with blood, to which this name has been applied from its position beneath the clavicle. This vessel of the limb is derived from the branching of the innominate artery behind the sterno-clavicular articulation, and the part of it named subclavian extends as far as the lower border of the first rib. To reach the limb the artery crosses the lower part of the neck, taking an arched course over the bag of the pleura and the first rib, and between the scaleni muscles. For the purpose of describing the numerous connections of the subclavian artery the vessel may be divided into three parts: the first extending from the sterno-clavicular articulation to the inner border of the anterior scalenus; the second, beneath the scalenus; and the third, from the outer border of that muscle to the lower edge of the first rib. Subclavian artery; extends to upper limb, and is divided into three parts.

First part.—Internal to the anterior scalenus the artery lies deeply in the neck, and ascends slightly from the level of its origin. Between the vessel and the surface will be found the common tegumentary coverings and the deep fascia, the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and a deep process of fascia from the inner border of the scalenus muscle. Crossing the artery near the scalenus are the large internal jugular, and the small vertebral vein; and internal to these veins is the pneumo-gastric nerve. Some branches of the sympathetic are likewise placed in front of the vessel. This part of the subclavian lies over the longus colli muscle, though at some distance from it, and separated from it by connective tissue, by the recurrent branch of the pneumo-gastric nerve, and by the sympathetic nerve. Below the artery, both in this and the next part, is the pleura, which ascends into the arch formed by the vessel. First part internal to scalenus is deep. Parts in front, behind, below.

Branches. Three branches arise from the subclavian in this part of its extent.

Second part beneath scalenus. Parts in front, *Second part.*—Beneath the scalenus the vessel is less deep than it is when internal to that muscle, and at this spot it rises highest above the clavicle. This second part, like the first, is covered by the integuments, platysma, and deep fascia; then by the clavicular origin of the sterno-mastoideus; and lastly by the anterior scalenus with the phrenic nerve. behind, above. Behind the vessel is the middle scalenus. And above it, in the interval between the scaleni, are the large trunks of the lower cervical nerves; with the exception of the trunk formed by the union of the last cervical and first dorsal, that lies between the artery and the middle scalenus. The subclavian vein is below the level of the artery, and separated from it by the anterior scalenus muscle. One branch. From this part of the subclavian one branch takes its origin.

Third part *Third part.*—Beyond the scalenus the subclavian artery is contained in the clavicular part of the posterior triangular space (p. 58.), and is nearer the surface than in the rest of its course. is superficial. This part of the artery is comparatively superficial whilst in the space before mentioned, for it is covered only Parts covering it; by the integuments, the platysma and deep fascia, with some superficial nerves of the cervical plexus, and the external jugular vein; beneath but near its termination the vessel gets under cover of the suprascapular artery and vein, and the clavicle and subclavius muscle. In the third part of its course the artery rests on the surface of the first rib. above and below. Above the vessel is the brachial plexus, and below it is the subclavian vein. Usually no branch leaves the last part of the artery.

Peculiarities of origin of the trunk; *Peculiarities.*—There are some peculiarities affecting the origin, the course, and the level in the neck of the subclavian artery.

With reference to origin. The level at which it springs from the innominate trunk may vary; so that in one case it may be above the sterno-clavicular articulation, in another, below that joint. Or the artery may spring as a separate trunk from the arch of the aorta; and in such a state of the parts, the vessel takes a deeper place than usual to reach the scaleni muscles:—a condition that will be referred to with the arch of the aorta in the thorax. course and level. It has been before said (p. 59.) that the artery may be in front of the scalenus or in its fibres; or that it may be placed one inch and a half above the level of the clavicle.

Branch- *Branches of the subclavian.*—Usually there are four

branches to the subclavian artery. Three of these arise from the first part of the arterial trunk;—one (vertebral) ascends to the head; another (internal mammary) descends to the chest; and the remaining one (thyroid axis) is a short thick trunk, which furnishes branches inwards and outwards. These arise commonly near the scalenus muscle, so as to leave an interval at the origin free from offsets. This interval varies in length, being from half an inch to an inch in the greater number of cases; and its extremes range from somewhat less than half an inch to an inch and three quarters. But in some instances the branches are scattered over the whole extent of this part of the artery (Quain).* The fourth branch (superior intercostal) arises from the second part of the artery, viz. that beneath the anterior scalenus, and gives off the deep cervical branch. If there is a branch present on the third part of the artery, it is commonly the posterior scapular: if more than one, the internal mammary, and some offsets belonging usually to the thyroid axis will be added.

es of subclavian artery.

Origin of the branches.

1. The *vertebral artery* is generally the first and largest branch of the subclavian, and arises from the upper and posterior part of that vessel. Ascending between the contiguous borders of the scalenus and longus colli muscles, this branch enters the aperture between the transverse processes of the sixth cervical vertebra, and is continued upwards to the skull through the chain of foramina in the transverse processes of the other cervical vertebræ. Before the artery enters the transverse process it is partly concealed by the internal jugular vein, and passes beneath the thyroid artery; it is accompanied by branches of the sympathetic nerve, and supplies small muscular offsets. Its course and distribution will be given afterwards.

Vertebral artery in the neck.

Small branches.

On the left side the commencement of the vertebral artery is crossed by the thoracic duct.

On left side.

The origin of the vertebral may vary in its position along the first part of the trunk of the subclavian; or it may be transferred to the arch of the aorta, especially on the left side; or to the right

Difference in place of origin.

* The student is referred for fuller information respecting the peculiarities of the vessels, and the practical applications to be deduced from them, to the original and valuable work on the Anatomy of the Arteries of the Human Body, by Richard Quain, F.R.S.

common carotid artery, when the subclavian of the same side arises from the aorta. The course of the artery is not constant through the hole between the transverse processes of the sixth vertebra; it may enter any other as high as the second.

Vertebral vein, and branches. The *vertebral vein* issues with its accompanying artery, to which it is superficial in the neck, and is directed over the subclavian artery to join the subclavian vein; it receives the *deep cervical vein*, and the *branch* that accompanies the ascending cervical artery.

Internal mammary artery in the neck. 2. The *internal mammary branch* leaves the lower part of the subclavian artery, and coursing downwards beneath the clavicle and subjacent muscle, and the subclavian vein, enters the thorax between the first rib and the bag of the pleura. As the artery is about to enter the chest, it is crossed (superficially) by the phrenic nerve. The vessel is distributed to the walls of the chest and abdomen; and its anatomy will be given with the dissection of those parts.

Thyroid axis divides into three. 3. *Thyroid axis.*— This is a short thick trunk, that arises from the front of the artery near the anterior scalenus muscle, and soon divides into three branches: — one to the thyroid body, and two to the scapula that run outwards across the neck. On the left side of the body the thoracic duct lies in front of the thyroid axis.

Suprascapular branch. *a.* The *suprascapular branch* courses outwards across the lower part of the posterior triangular space of the neck, behind the clavicle and subclavian muscle, to the superior costa of the scapula, and entering the supraspinal fossa is distributed on the dorsum of that bone. The connections of this artery are seen in the dissection of the back.

Transverse cervical branch. *b.* The *transverse cervical branch*, usually larger than the preceding, takes a similar direction, though higher in the neck, and ends beneath the border of the trapezius muscle in the superficial cervical and posterior scapular arteries. (See "DISSECTION OF THE BACK.") In its course outwards this artery crosses the anterior scalenus, the phrenic nerve, and the brachial plexus, and lies in the upper part of the space that contains the third part of the Offsets. subclavian artery. Some small branches are supplied by it to the posterior triangular space of the neck.

Size and ending vary. Though the transverse cervical artery supplies ordinarily the posterior scapular branch, there are many examples in which, though holding its usual position in the neck, it is too small in size to give origin to so large an offset. In such instances the diminished artery ends in the trapezius muscle, whilst the posterior

scapular branch arises separately from the third, or even the second part of the subclavian artery.

c. The *inferior thyroid branch* is the largest offset of the thyroid axis. Directed inwards to the thyroid body, the artery passes beneath the common carotid artery and the accompanying vein and nerves, and in front of the longus colli muscle and the recurrent nerve. In this course the vessel is tortuous. At the lower part of the thyroid body it divides into branches that enter the under surface, whilst others communicate with the superior thyroid, and with the corresponding artery of the opposite side, forming a very free anastomosis between these vessels. Near the larynx a *laryngeal branch* is distributed to the back of that tube, and other offsets are furnished to the trachea.

Inferior thyroid branch gives laryngeal offset,

The *ascending cervical artery* is a branch of the thyroid near its commencement; it is directed upwards between the scalenus and rectus capitis anticus major, and ends in branches to those muscles and to the posterior triangle of the neck. Some small spinal offsets are conveyed along the spinal nerves to the cord and its membranes.

and ascending cervical branch.

d. Lowest thyroid.—In connection with the thyroid body a third thyroid artery may be occasionally present, which has been named art. thyroidea ima. This offset usually comes from the trunk of the innominate artery, but it may spring from the right common carotid, or from the arch of the aorta. Whatever its origin, the small vessel ascends in front of the trachea to the thyroid body, and either takes the place of an absent inferior thyroid artery, or assists a smaller vessel than usual in supplying that body.

Accessory branch to the lower thyroid.

The *veins* corresponding to the branches of the thyroid axis have the following destination:—those with the suprascapular and transverse cervical arteries open in the external jugular vein. But the inferior thyroid vein begins in a plexus connected with the thyroid body, and descends in front of the trachea, beneath the muscles covering this tube, to end in the innominate vein.

Veins corresponding to arteries.

4. The *superior intercostal artery* arises from the posterior part of the subclavian, and bends downwards over the neck of the first rib to the thorax. Its distribution to the first two intercostal spaces will be seen in the thorax.

Superior intercostal artery in neck.

Arising in common with this branch is the *deep cervical artery* (art. profunda cervicis). Analogous to the dorsal branch of an intercostal artery (Quain), it passes backwards between the transverse process of the last cervical vertebra and the first rib, and ends beneath the complexus muscle at the posterior part of the neck.

Deep cervical artery.

Subclavian vein; The SUBCLAVIAN VEIN has nearly the same limits as the artery of the same name, viz., from the lower border of the first rib to the sterno-clavicular articulation. It is a continuation upwards of the axillary vein, and ends by joining the internal jugular to form the innominate vein. Its course is nearly straight, and commonly below the level of the artery, from which it is separated by the anterior scalenus muscle. its branches; The anterior and external jugular join this vein outside the scalenus, and the vertebral vein enters it inside that muscle. opening of lymphatic ducts. Into the angle of union of the subclavian and jugular veins the right lymphatic duct opens; and at the same spot, on the left side, is the entrance of the large lymphatic duct. It should be borne in mind that not unfrequently the vein is as high in the neck as the third part of its companion artery; and that the vein has been twice seen with the artery beneath the anterior scalenus.

Cervical nerves. The ANTERIOR PRIMARY BRANCHES OF THE CERVICAL NERVES spring from the common trunks in the intervertebral foramina, Position and number. and appear on the side of the neck between the intertransverse muscles. These spinal nerves are eight in number, and are equally divided between the cervical and the brachial plexus; the highest four being combined in the former, and the remaining nerves in the latter plexus. At their commencement the nerves intermix by communicating branches, and receive offsets of communication from the sympathetic.

First two differ from rest. To this general statement respecting the position of the nerves between the intertransverse muscles, some modification is necessary for the first two nerves; and the peculiarities concerning them will be noticed in *Section* 18.

Brachial plexus; BRACHIAL PLEXUS.— The first dorsal and four lower cervical nerves are blended in this plexus, and a fasciculus is added to them from the lowest nerve entering the cervical plexus. formed by five nerves. Thus formed, the plexus reaches from the lowest part of the neck to the axilla, where it ends in nerves for the upper limb. Only the part of it above the clavicle can now be seen. In the neck the nerves have but little of a plexiform disposition: they lie at first between the scaleni muscles, and have the following arrangement: —

Disposi- The fifth and sixth nerves unite near the vertebræ; the

seventh remains distinct as far as the outer border of the middle scalenus; and the last cervical and first dorsal are blended in one trunk beneath the anterior scalenus; so that they are combined at first into three cords. Near the attachment of the middle scalenus to the rib, the seventh nerve throws itself into the trunk formed by the fifth and sixth, and then there result two cords to the plexus:—the one formed by the fifth, sixth, and seventh cervical nerves; and the other, by the eighth cervical and the first dorsal nerve. These two trunks accompany the subclavian artery, lying to its acromial side, and are continued to the axilla, where they are more intimately blended. tion of nerves in the plexus in the neck.

Branches. — The branches of the plexus may be classed into those above the clavicle, and those below that bone. The highest set end mostly in the muscles of the lower part of the neck, and in those of the chest and shoulder; whilst the other set consist of the terminal branches, and are furnished to the upper limb, with which they will be referred to. Branches in the neck are:

Branches above the Clavicle.— 1. *Branch to the phrenic nerve.* This offset comes from the trunk of the fifth cervical nerve, and joins the phrenic on the anterior scalenus muscle. To phrenic nerve,

2. The *branch to the subclavius muscle* is a very slender twig, that arises from the trunk formed by the fifth and sixth nerves, and is directed downwards over the subclavian artery to the under-surface of the muscle; it is often united with the phrenic nerve at the lower part of the neck. Nerve of subclavius,

3. The *branch for the rhomboid muscle* springs from the fifth nerve in the substance of the middle scalenus, and perforates the fibres of that muscle; it is afterwards directed beneath the levator anguli scapulæ to its destination. Branches are usually given from this nerve to the levator anguli scapulæ. Nerve of rhomboideus,

4. The *posterior thoracic nerve* (nerve of the serratus, external respiratory nerve of Bell) is contained in the scalenus, like the preceding, and arises from the fifth and six nerves, near the intervertebral foramina. Piercing the fibres of the scalenus lower than the preceding branch, the nerve is continued behind the brachial plexus, and enters the serratus magnus muscle on the axillary surface. Nerve of serratus,

5. *Branches for the scaleni and longus colli muscles.*—These are small twigs that are seen when the anterior scalenus is divided; they arise from the trunks of the nerves as soon as these leave the spinal canal. Nerves of scaleni and longus colli,

6. The *suprascapular nerve* is larger than either of the others. Supra-

scapular nerve.

It arises near the subclavian branch from the same cord of the plexus, viz., that formed by the fifth and sixth nerves. Its destination is the dorsum of the scapula, on which it will be dissected with the arm.

Cervical plexus is formed by branching of the nerves.

The CERVICAL PLEXUS is formed by the anterior primary branches of the first four cervical nerves. Situate at the upper part of the neck, it lies beneath the sterno-mastoid muscle, and on the middle scalenus and the levator anguli scapulæ. Its appearance differs much from that of the brachial plexus, for it resembles a network more than a bundle of large cords. The following is the general arrangement of the nerves in the plexus: — each nerve, except the first, divides into an ascending and descending branch, and these unite with similar parts of the contiguous nerves, so as to give rise to a series of arches. From these loops or arches the different branches arise.

Its offsets are superficial, and deep.

Branches. — The branches of the plexus are both superficial and deep. The superficial set are described with the triangular space of the neck, as consisting of ascending and descending nerves (p. 60.). In this stage of the dissection the ascending branches are seen to spring from the union of the second and third nerves, and the descending ones to come from the loop between the third and fourth nerves. The deep set of branches remain now to be examined.

Deep branches are:

The DEEP BRANCHES OF THE PLEXUS are both muscular and communicating, and may be arranged into an internal and an external series.

Phrenic nerve,

A. INTERNAL SERIES. — 1. The *phrenic or muscular nerve* of the diaphragm is derived from the fourth, or third and fourth nerves of the plexus, and it may be joined by a fasciculus from the fifth cervical nerve. Descending obliquely on the surface of the anterior scalenus, from the outer to the inner edge, it enters the chest in front of the internal mammary artery, but behind the subclavian vein, and traverses that cavity to reach the diaphragm. At the lower part of the neck the phrenic nerve is joined by a filament of the sympathetic, and sometimes by an offset of the nerve to the subclavian muscle.

Nerves to join descendens noni,

2. The *branches communicating with the descendens noni* are two in number. One of these arises from the second, and the other from the third cervical nerve; they are directed inwards either over or under the internal jugular vein, and communicate with the descending muscular branch (descendens noni) of the hypoglossal nerve.

3. *Muscular branches* are furnished to the recti muscles; these arise from the loop between the first two nerves, and from the trunks of the other nerves close to the intervertebral foramina. Branches to recti,

4. Some *connecting branches* pass from the loop between the first two nerves to the sympathetic, and to the cranial nerves near the base of the skull: these will be afterwards described. Branches to other nerves.

B. External or Posterior Series.—1. *Muscular branches* are given from the second nerve to the sterno-mastoideus; from the third nerve to the levator anguli scapulæ; and from the third and fourth nerves to the trapezius. Further, some small branches supply the substance of the middle scalenus. Branches to muscles,

2. *Connecting branches with the spinal accessory nerve.*—The communications between this cranial and the spinal nerves are numerous. First, in the sterno-mastoid muscle; next, in the posterior triangular space; and, lastly, beneath the trapezius. The union with those branches that are distributed to the trapezius has the appearance of a plexus. Branches joining spinal accessory.

The common carotid artery is the leading vessel for the supply of blood to the neck and head, and is remarkable in not furnishing collateral branches. The origin of the vessel is different on opposite sides of the body, being on the right, at the lower part of the neck, and on the left side, in the thorax. Common carotid artery.

The vessel of the right side commences opposite the sterno-clavicular articulation at the bifurcation of the innominate artery, and ends at the upper border of the thyroid cartilage by dividing into the two trunks before seen, viz., external and internal carotid. The course of the artery is along the side of the trachea and larynx, gradually diverging from the vessel on the opposite side in consequence of the increasing size of the larynx; and its position will be marked by a line from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. Contained in a sheath of cervical fascia, with the internal jugular vein to the outside, and the pneumogastric nerve between the two, the carotid artery has the following connections with the surrounding parts:—As high as the cricoid cartilage the vessel is deeply placed, and is concealed by the common coverings of the skin, platysma and fasciæ, and by the muscles at the lower part of the neck, viz., sterno-mastoid (sternal origin), sterno-hyoid, sterno-thyroid, Origin. Course. Situation. Parts covering it,

and omo-hyoid; and beneath the muscles by the middle thyroid vein. But above the cricoid cartilage to its termination the artery is covered only by the sterno-mastoid and the common investments of the part; superficial to it here is the descendens noni nerve, and crossing the upper part are offsets of the superior thyroid artery with the accompanying vein. The vessel rests mostly on the longus colli muscle, but close to its ending on the rectus capitis anticus major; on the sympathetic nerve and its branches; and on the recurrent nerve and the inferior thyroid artery. To the inner side of the carotid lie the trachea and larynx, with the œsophagus and the thyroid body, the last overhanging the vessel by the side of the larynx. Along the outer side of the carotid sheath is a chain of lymphatic glands.

beneath it,

and on its sides.

Internal jugular vein

INTERNAL JUGULAR VEIN. — This vein extends upwards to the base of the skull by the side of the carotid blood-vessels, but only the part of it that accompanies the common carotid artery is now seen. Placed behind or posterior to its artery, the vein ends below by uniting with the subclavian in the innominate vein. Its proximity to the carotid is not equally close in all the extent of this vessel, for at the lower part of the neck the vein inclines backwards, leaving a space between it and the artery, in which the vagus nerve is seen about midway between the two. Sometimes the vein is superficial to the artery as on the left side. In this part of its course the vein receives the superior and middle thyroid branches.

lies close to side of artery,

except below.

Branches.

Differences in origin;

Peculiarities.— Some of the following peculiarities of the common carotid may be met with. Its origin on the right side may be above or below the point above stated; or it may be transferred to the arch of the aorta, or to the left carotid in the thorax. Mention has been made of the difference in the place of bifurcation, and of the fact that, occasionally, the common carotid artery is not divided into two. (See page 65.)

in number.

Instead of one there may be two trunks issuing from beneath the hyoid muscles, for the common carotid has been found divided in one case after an extent of one inch and a half. As an extremely rare occurrence its usual terminal branches, the external and internal carotids, may arise as distinct arteries from the arch of the aorta.

Its

Usually the common carotid is without branch, but it may give

origin to the superior thyroid, the inferior thyroid, or the vertebral artery. branches.

Dissection. — The dissector may next trace out completely the trunk of the external carotid, and follow its branches until they disappear beneath different parts. Afterwards he may separate from one another the digastric and stylo-hyoid muscles, which cross the carotid, and define their origin and insertion. Dissection.

The DIGASTRIC MUSCLE consists of two fleshy bellies, united by an intervening tendon, whence its name. The posterior belly, the larger of the two, *arises* from the groove beneath the mastoid process, whilst the anterior belly takes origin from the base of the lower jaw, on the side of the symphysis. From these places of origin the fibres are directed to the intervening tendon: — those of the posterior belly are the longest, and are inclined obliquely forwards, and those of the anterior belly pass more vertically downwards. The tendon of the muscle is surrounded by fibres of the stylo-hyoideus; and it is attached to its fellow and to the os hyoides by means of an aponeurotic expansion, that keeps in position the arch of the muscle, and is inserted below into the body, and a part of the great cornu of the hyoid bone. The arch formed by the digastric is superficial, except at the outer part, where it is beneath the sterno- and trachelo-mastoid muscles. The posterior belly crosses the carotid vessels and the accompanying veins and nerves; and is placed across the anterior triangular space of the neck in the position of a line from the mastoid process to a little above the hyoid bone; along its lower border will be found the occipital artery and the hypoglossal nerve, the former passing backwards, the latter forwards. The anterior belly rests on the mylo-hyoid muscle.

Digastric muscle has two bellies, which are joined by a tendon.

Position to other parts.

The digastric muscle describes an arch across the side of the neck, and forms the lower boundary of a space that reaches upwards to the jaw and the mastoid process, and to the base of the skull in front of the ear. This space is divided into two parts by the stylo-maxillary ligament. In the posterior portion are contained the parotid gland and the vessels and nerves in connection with it (p. 31.); in the anterior are the submaxillary gland and the facial vessels,

The muscle bounds a space that contains parotid and submaxil-

lary glands. and deeper still the muscles between the chin and the hyoid bone.

Stylo-hyoideus. The STYLO-HYOID MUSCLE is thin and slender, and has the same position as the posterior belly of the digastric. It Origin. *arises* from the outer aspect of the styloid process, near the Insertion. base or about the middle, and is *inserted* into the body of the os hyoides. The muscle has the same connections as Surrounds digastric tendon. the posterior belly of the digastric: and its fleshy fibres are usually perforated by the tendon of that muscle. In many bodies the stylo-hyoid muscle is absent.

Ninth nerve in the anterior triangle. The HYPOGLOSSAL NERVE (ninth cranial) may now be examined, at least that part of it which is seen in the anterior triangle of the neck. Appearing at the lower edge of the digastric muscle, the nerve hooks round the occipital artery; it is then directed forwards below the digastric, and disappears in front beneath the mylo-hyoid muscle. As the nerve crosses the neck, it lies over the carotid vessels; and near the cornu of the os hyoides it crosses the lingual artery, so as to become highest of the two.

Its branches here are muscular. *Branches.*—In this part of its course the nerve gives the descendens noni branch and a small muscular offset to the thyro-hyoideus.

Branch to lower hyoid muscles The *descending branch* (ram. descend. noni) arises from the trunk of the hypoglossal on the outer side of the carotid artery, and descends on the front, or in the sheath of the vessel, to about the middle of the neck, where it is joined by the communicating is joined with cervical nerves branches of the cervical nerves. After the union of the spinal nerves offsets are supplied to the lower hyoid muscles, viz. omohyoid (both bellies), sterno-hyoid, and sterno-thyroid. Sometimes another offset is continued to the thorax, where it joins the by intercommunicating fibres. phrenic and cardiac nerves. The connection between the descendens noni and the spinal nerves is formed by two or more cross filaments, so as to construct an arch with the concavity upwards; and an interchange of filaments between the two nerves has been described.

External carotid vessel. The EXTERNAL CAROTID ARTERY springs from the bifurcation of the common carotid at the upper border of the thyroid cartilage, and furnishes branches to the face, the neck, and the outer parts of the head.

Extent. From the place of origin the vessel ascends to the interval between the jaw and the mastoid process, and ends in the

internal maxillary and temporal branches, near the condyle of the jaw. In this course the artery lies at first to the inner side of the internal carotid, but it afterwards becomes superficial to this vessel; and its direction is somewhat arched forwards, though the position would be marked sufficiently by a line from the front of the meatus of the ear to the cricoid cartilage. At first the external carotid is comparatively superficial, and easily reached from the surface, being overlaid only by the sterno-mastoideus and the common coverings of the anterior triangular space, viz. the skin, the superficial and deep fasciæ with the platysma, and the superficial nerves. But above the situation of a line extended from the mastoid process to the hyoid bone, the carotid artery is crossed by the digastric and stylo-hyoid muscles with the hypoglossal nerve; and still higher it enters the substance of the parotid gland, where it lies beneath the facial nerve and the external jugular vein. The external carotid is also crossed by the facial and lingual branches of veins joining the internal jugular trunk. At first the artery is situate over the superior laryngeal nerve, and is unsupported by muscular fibre, though it rests against the pharynx; but above the angle of the jaw it is placed over the styloid process and the glosso-pharyngeal nerve, which separate it from the internal carotid. To the inner side of the vessel at first is the pharynx, and still higher are the ramus of the jaw and the stylo-maxillary ligament. In certain conditions a companion vein from the temporal and internal maxillary (p. 32.) will accompany the arterial trunk.

Course and direction.

Parts superficial to it,

beneath it,

and on inner side.

The *branches* of the external carotid are numerous, and are classed into an anterior, posterior, and ascending set. The anterior set comprise branches to the thyroid body, the tongue, and the face, viz. superior thyroid, lingual, and facial arteries; in the posterior set are the occipital and posterior auricular branches; and the ascending set include the ascending pharyngeal, temporal, and internal maxillary arteries. Besides these, the carotid gives other branches to the sterno-mastoid muscle and the parotid gland.

Its branches are anterior, posterior, and ascending:

The regular origin of the branches, as this will be described below, may be departed from by means of the closer aggregation of the branches on the trunk of the carotid. And further, the usual number may be diminished by two or more

change in origin and in number.

taking origin in common; or the number may be increased by some of the secondary offsets being transferred to the parent trunk.

Branches now seen are

All the branches, except the ascending pharyngeal, lingual, and internal maxillary, may now be examined; but those three will be afterwards described with the regions they occupy.

Superior thyroid,

The *superior thyroid artery* arises near the cornu of the os hyoides, and runs downwards on the inner side of the common carotid artery, passing beneath the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles, to the thyroid body, to which it is distributed on the anterior aspect. This branch is superficial in the anterior triangle, and furnishes offsets to the lowest constrictor as well as to the muscles beneath which it lies, in addition to the following named branches: —

has offsets to

the hyoid bone,

a. The *hyoid branch* is very inconsiderable in size, and runs inwards below the hyoid bone: it supplies the parts attached to that bone, and anastomoses with the vessel of the opposite side.

sterno-mastoid muscle,

b. A branch for the *sterno-mastoid muscle* lies in front of the sheath of the common carotid artery, and is distributed chiefly to the muscle from which it takes its name.

to larynx,

c. The *laryngeal branch* pierces the membrane between the hyoid bone and thyroid cartilage, with the superior laryngeal nerve, and ends in the interior of the larynx.

to crico-thyroid membrane.

d. A small *crico-thyroid branch* is placed on the membrane between the cricoid and thyroid cartilages, and communicates with the corresponding artery of the opposite side, forming an arch.

Accompanying vein.

The *superior thyroid vein* commences in the larynx and the thyroid body, and crosses the end of the common carotid artery to open into the internal jugular vein.

Facial artery.

The *facial artery* arises above the lingual, and is directed upwards over the lower jaw to the face. In the neck the artery passes beneath the digastric and stylo-hyoid muscles, and is afterwards received on the submaxillary gland, on which it makes a remarkable sigmoid turn. Its disposition in the face has been examined (p. 29.). The cervical part of the artery gives branches to the pharynx, and to the structures below the jaw, viz.: —

supplies branches in the neck

to the palate,

a. The *inferior palatine branch* ascends to the pharynx beneath the jaw, passing between the stylo-glossus and stylo-pharyngeus muscles; furnishing a branch to the tonsil, it is distributed to the

soft palate. This branch frequently arises from the ascending pharyngeal artery.

b. The *tonsillar branch* is smaller than the preceding, and ascends between the internal pterygoid and stylo-glossus muscles. Opposite the tonsil it perforates the constrictor muscle, and ends in offsets to that body. tonsil,

c. *Glandular branches* are supplied to the submaxillary gland from the part of the artery in contact with it. sub-maxillary gland

d. The *submental branch* arises near the inferior maxilla, and passes forwards on the mylo-hyoideus to the anterior belly of the digastric muscle, where it ends in branches; some of these turn over the jaw to the chin and lower lip; and the rest supply the muscles between the jaw and the hyoid bone, one or two perforating the mylo-hyoideus and anastomosing with the sublingual artery. and mylo-hyoid muscle.

The *facial vein* (p. 30.) joins the internal jugular vein. In the cervical part of its course it receives branches corresponding to those of the artery, and often throws itself into the temporo-maxillary trunk. Facial vein.

The *occipital artery* is of considerable size, and is destined for the back of the head. It arises from the carotid opposite the facial branch, and near the lower border of the digastric muscle. From this spot the artery ascends to the inner part of the mastoid process of the temporal bone; next it turns horizontally backwards on the occipital bone, passing above the transverse process of the atlas; and finally becomes cutaneous near the middle line (p. 6.). In the neck this artery passes beneath the digastric muscle and a part of the parotid gland; and crosses over the internal carotid artery, the jugular vein, and the spinal accessory and hypoglossal nerves. Occipital artery ends on occiput; in neck has an offset to

The only offset from the artery in the front of the neck is a small *posterior meningeal branch* to the dura mater in the posterior fossa of the base of the skull. This ascends along the internal jugular vein, and enters the skull by the foramen jugulare (p. 18.). The branches at the back of the neck will be afterwards seen. the dura mater.

The *occipital vein* begins at the back of the head (p. 7.), and has the same course as the artery; it communicates with the lateral sinus through the mastoid foramen, also with the diploic veins, and opens into the internal, sometimes into the external jugular vein. Occipital vein.

The *posterior auricular artery* is smaller than the pre- Poste-

rior auricular artery in neck supplies

ceding branch, and takes origin above the digastric muscle. Ascending in the same direction as the occipital artery, viz. to the interval between the ear and the mastoid process, it divides finally into two branches for the ear and occiput p. 6.).

a branch to the ear.

A small branch, *stylo-mastoid*, enters the foramen of the same name, and supplies the internal ear.

Vein with artery.

The *vein* with the artery receives a stylo-mastoid branch, and terminates in the trunk formed by the temporal and internal maxillary veins.

Temporal artery,

The *temporal artery* is in direction the continuation of the external carotid trunk, and is one of the terminal branches of that artery. Ascending through the parotid gland, in the interval between the ear and the articulation of the jaw, the vessel divides on the temporal fascia, about two inches above the zygoma, into anterior and posterior branches; and these are distributed to the front and side of the head (p. 6.). The trunk of the artery gives offsets to the surrounding parts, viz.: —

besides terminal branches, gives

branches to parotid, to articulation of jaw, and the ear.

a. Parotid branches are furnished to the gland which conceals the artery. *Articular* twigs are supplied to the articulation of the lower jaw; and other *muscular* branches enter the masseter. Some *anterior auricular* branches are distributed to the pinna and meatus of the external ear.

Branch to face.

b. The *transverse facial branch* quits the temporal artery opposite the condyle of the jaw, and is directed forwards over the masseter muscle (p. 30.); on the side of the face it supplies the muscles and the integuments, and anastomoses with the facial artery.

Branch to temporal muscle

c. The *middle temporal branch* arises just above the zygoma, and pierces the temporal aponeurosis to enter the substance of the temporal muscle. In the muscle it anastomoses with branches of the internal maxillary artery.

and of the temple.

d. A small branch of the temporal artery is likewise found between the layers of the temporal fascia; this becomes cutaneous near the orbicularis muscle.

Corresponding vein.

The *temporal vein* commences on the side of the head (p. 7.), and is contiguous to its companion artery. Near the zygoma it is joined by the middle temporal vein; next by other branches corresponding to those of the artery; and finally it ends by uniting with the internal maxillary vein.

Directions.—The lower part of the neck will not be again

returned to for some days, so that the dissector may stitch together the flaps of skin, when he has applied a fluid to preserve it.

Section VI.

PTERYGO-MAXILLARY REGION.

In this region are included the muscles superficial to and beneath the ramus of the jaw, together with the articulation of the bone. In connection with the muscles (pterygoid) beneath the ramus of the jaw, are the internal maxillary blood-vessels, and the inferior maxillary trunk of the fifth nerve. Contents of the region.

Dissection.—The masseter muscle, which is superficial to the jaw, comes first from without inwards. To see it the branches of the facial nerve and the transverse facial artery should be cut through, and turned backwards off the face. A little cleaning will suffice to show the fibres, and to define the origin and insertion of the muscle. Should there be in the mouth any of the material that made tense the fibres of the orbicularis, let it be removed. Dissection.

The MASSETER MUSCLE conceals the ramus of the lower jaw, and is divided into two portions, superficial and deep, by means of an aponeurosis, which projects at the upper part into the muscular fibres. Masseter has two parts.

The superficial part *arises* from the anterior two-thirds of the zygomatic arch, and its fibres are directed downwards and backwards to be *inserted* into the angle, and into the lower half of the ramus of the jaw on the outer aspect. Superficial is directed backwards. The deeper part takes *origin* by fleshy fibres from the remaining third, and from all the posterior surface of the arch; and its fibres, taking an opposite direction to those of the superficial part, are *inserted* into the outer surface of the coronoid process, and the ramus of the jaw above the attachment of the other portion of the muscle. Deep part forwards.

The lower part of the masseter is subcutaneous, but the upper is partly concealed by the parotid gland (socia parotidis), and is crossed by Stenson's duct, and by the transverse facial vessels and the facial nerve. Muscle nearly subcutaneous; The anterior border projects over the buccinator muscle, and a quantity of fat resembling that in the orbit is found beneath it. The muscle lies on

the jaw. covers the ramus of the jaw, and the masseteric branches of nerve and artery that enter it at the under surface.

To see surface of temporal muscle. *Dissection.*—To lay bare the temporal muscle to its insertion, the following dissection may be made:—The temporal fascia is to be detached from the upper border of the zygomatic arch, and removed from the surface of the muscle. Next, the arch is to be sawn through, in front and behind, so as to include its whole length; and to be thrown down (without being cut off) with the masseter muscle still attached to it, by separating the fibres of the muscle from the upper part of the ramus of the jaw. In detaching the masseter muscle, the nerve and artery to it, that appear through the sigmoid notch, will be found. The surface and insertion of the temporal muscle may then be cleaned.

Insertion. Afterwards, to see the insertion and extent of origin of the muscle, let the coronoid process be sawn off by a cut passing from the centre of the sigmoid notch nearly to the last molar tooth, so as to include the whole of the insertion of the muscle; and in this proceeding let the student be careful of the buccal artery and nerve issuing from beneath it. Lastly, the coronoid process should be raised in order that the extent of the lower fibres of the temporal muscle, and their contiguity to the external pterygoid, close below them, may be observed.

Origin of temporal muscle. The *temporal muscle* has been before seen to occupy the upper part of the temporal fossa (p. 4.); and by the previous dissection the lower part has been laid bare. The *origin* of the muscle is the following:—It occupies the whole of the temporal fossa, reaching up to the semicircular line on the side of the skull, and downwards to the crest on the outer aspect of the great wing of the sphenoid bone. From this extensive origin, as well as from the fascia over it, the fibres converge to a superficial tendon, which is *inserted* into all the inner surface of the coronoid process, from the apex to near the last molar tooth. Behind the posterior border of the tendon are the masseteric vessels and nerve, and in front of it the buccal vessels and nerve: the last nerve occasionally perforates some of the fibres of the muscle.

Insertion.

To dissect pterygoid. *Dissection.*—For the display of the pterygoid muscles, it will be necessary to remove a piece of the ramus of the jaw. But first, the greater part of the temporal muscle is to be

detached from the subjacent bone with the handle of the scalpel, and the deep temporal vessels and nerves to be sought in its fibres. A piece of the ramus of the jaw is next to be removed, but without injuring the vessels and nerves in contact with its inner surface, by sawing across the bone close to the condyle, and again close above the dental foramen; and to make the dental vessels and nerve secure from injury, the handle of the scalpel may be inserted close beneath the bone and carried downwards to their entrance into the foramen. The masseteric artery and nerve are liable to be cut in sawing the bone; should these be divided, turn them upwards for the present, and afterwards tie together the ends. After the loose piece of bone has been removed, and the subjacent parts freed from fat, the pterygoid muscles will appear,—the external being directed outwards to the condyle of the jaw, and the internal, which is parallel in direction to the masseter, being inclined to the angle of the jaw. In removing the fatty tissue, the student must be careful not to take away the thin fascia of the internal lateral ligament, which is beneath the ramus.

Position of the parts. Many vessels and nerves will be found in this region, with the following position to other parts. Crossing inwards over the external pterygoid muscle, is the internal maxillary artery, which distributes offsets upwards and downwards; sometimes this artery will be placed beneath the muscle. Escaping from beneath the lower border of the same muscle are the large dental and gustatory nerves, the latter being the more internal of the two; and appearing between the upper border of the muscle and the cranium, are the masseteric and deep temporal nerves. The buccal branch of nerve perforates the fibres of the external pterygoid near its inner attachment. Branches of the above-mentioned artery accompany these nerves. At the front of the space now dissected, coursing along the posterior part of the upper jaw, is the small posterior dental nerve with an artery.

Inter-maxillary band. Between the jaws is the whitish narrow band of the pterygo-maxillary ligament, to which the buccinator and superior constrictor muscles are connected.

External pterygoid is horizontal. The EXTERNAL PTERYGOID MUSCLE extends almost horizontally from the zygomatic fossa to the condyle of the lower jaw. Its *origin* is from the surface of bone corresponding to

the zygomatic fossa, viz. from the great wing of the sphenoid bone below the crest, from the outer aspect of the external pterygoid plate, and from the tuberosity of the palate, and of the superior maxillary bone. The fibres are directed outwards and somewhat backwards, those attached to the margin of the spheno-maxillary fissure forming at first a separate bundle, and are *inserted* into the hollow in front of the neck of the lower jaw bone, and into the interarticular fibro-cartilage of the joint. Externally the muscle is concealed by the temporal muscle and the lower jaw, and the internal maxillary artery lies on it. By the deep surface it is in contact with the inferior maxillary nerve, with a plexus of veins, and with the internal lateral ligament. The parts in contact with the borders of the muscle have been enumerated in the dissection of the region. Sometimes the slip of the muscle, attached to the margin of the spheno-maxillary fissure and the root of the external pterygoid plate, is described as a separate head with an insertion chiefly into the interarticular cartilage.

Attachments. Insertion. Contiguous parts. A second head.

The INTERNAL PTERYGOID MUSCLE is nearly parallel to the ramus of the jaw, and its fibres are longer than those of the preceding muscle. *Arising* from the pterygoid fossa, but chiefly from the inner surface of the external pterygoid plate, the fibres descend to be *inserted* into the angle and inner surface of the ramus of the jaw, as high as the inferior dental foramen. On the muscle are placed the dental and gustatory nerves, the dental artery, and the internal lateral ligament. The deep surface is in connection below with the superior constrictor, and at its origin with the tensor palati muscle.

Internal pterygoid is beneath the ramus of the jaw; vessels and nerves around.

Directions. — Before proceeding farther in the dissection, the student may learn now the anatomy of the articulation of the lower jaw.

Joint of lower jaw.

TEMPORO-MAXILLARY ARTICULATION. — In this joint the condyle of the jaw is received into the anterior part of the hollow of the glenoid fossa of the temporal bone. The bones are retained in contact mostly by the strong muscles of the lower jaw; but the following ligaments are concerned in uniting them.

External

The *external lateral* is a short, ligamentous band, which

is attached above to the tubercle at the root of the zygoma, and below to the outer side of the neck of the inferior maxilla. lateral and

The *internal lateral ligament* is a long, thin, membranous band, which is not in contact with the joint. Superiorly it is connected by a pointed piece to the spinous process of the sphenoid, and the vaginal process of the temporal bone; and inferiorly it is inserted into the orifice of the dental canal in the lower jaw. This ligament lies beneath the ramus of the jaw, between it and the internal pterygoid muscle, and its origin is concealed by the external pterygoid muscle. Between the ligament and the jaw is the internal maxillary artery. internal lateral ligament.

Besides these ligaments there are some scattered fibres surrounding the articulation, which serve the purpose of a capsular membrane. Capsule

Dissection. — After the external lateral ligament and the capsule of the joint have been removed, an interarticular fibro-cartilage, with a synovial membrane above and below it, will be exposed. Dissection.

The *interarticular fibro-cartilage* is adapted to the surfaces of the bones. It is elongated transversely, is thinner in the centre than at the margins, and an aperture is sometimes present in the middle. The upper surface fits into the glenoid fossa, being concavo-convex from before backwards, and the lower is moulded to the convexity of the condyle of the jaw. Externally it is connected with the capsule and the external lateral ligament; and in front the external pterygoid muscle is attached to it. Fibro-cartilage; its form and attachments.

Two *synovial membranes* are present in the articulation— one above, and one below the fibro-cartilage. The lower one is the smaller of the two; and, besides investing the interior of the capsule, it extends from this to the surface of the jaw. Two synovial membranes.

Another structure — the *stylo-maxillary ligament* — is described as a uniting band to this articulation. This is a process of the deep cervical fascia, which extends from the styloid process to the hinder part of the ramus of the jaw. The piece of fascia here referred to, gives attachment to the stylo-glossus muscle, and separates the parotid and submaxillary glands. Stylo-maxillary ligament.

issection.

Dissection. — The condyle of the jaw is next to be disarticulated, still keeping the external pterygoid muscle uncut; and it with the attached muscle is to be drawn forwards so as to see the fifth nerve beneath; whilst cutting through the articular ligaments the dissector must be careful of the auriculo-temporal nerve close beneath. On drawing forwards the pterygoid muscle, and removing some connective tissue, the dissector will find the trunk and branches of the inferior maxillary nerve. All the four small muscular branches of the nerve should be traced to the trunk in the foramen ovale of the sphenoid bone; its auriculo-temporal branch should be followed backwards with care behind the articulation; and the small chorda tympani should be found joining the posterior part of the gustatory nerve near the skull. The middle meningeal artery is to be sought beneath the external pterygoid; and oftentimes the trunk of the internal maxillary artery will be found beneath that muscle.

Internal maxillary artery.

The INTERNAL MAXILLARY ARTERY is one of the terminal branches of the external carotid, and takes a winding course beneath the lower jaw and the temporal muscle to the spheno-maxillary fossa, where it ends in branches for the face, the interior of the nose, and the palate and pharynx.

Course and connections.

At first the artery is directed inwards beneath the jaw, between the bone and the internal lateral ligament of the joint, and crosses the dental nerve. Next, the vessel winds over the external pterygoid muscle, being placed between it and the temporal muscle. And lastly, the artery enters the spheno-maxillary fossa between the processes of origin of the external pterygoid muscle. The trunk of the artery may be divided into three parts: one beneath the jaw, a second between the muscles, and a third in the spheno-maxillary fossa. The course of the artery is sometimes beneath, instead of over the external pterygoid muscle: in such instances the artery gains the spheno-maxillary fossa by coming upwards through the origin of the muscle covering it.

Varies in its position.

Branches are three sets.

The *branches* of this artery are very numerous, and are classed into three sets, corresponding to the divisions made in the trunk of the artery: thus one set arises beneath the jaw, another beneath the temporal muscle, and another in the spheno-maxillary fossa.

Those beneath jaw,

Two branches, viz. the inferior dental and middle meningeal, leave the internal maxillary artery, whilst it is in connection with the ramus of the jaw.

inferior dental;

1. The *inferior dental branch* descends between the internal lateral ligament and the jaw, and enters the foramen on the inner surface of the ramus, along with the dental nerve, to supply the teeth.

has a branch to mylo-hyoid muscle;

As this artery is about to enter the foramen it furnishes a small twig, *mylo-hyoid branch*, to the muscle of that name; this is conducted by a groove on the inner surface of the bone, in company with a branch from the dental nerve, to the superficial surface of the mylo-hyoid muscle, where it anastomoses with the submental artery.

Middle meningeal artery, ends in skull, but gives

2. The *middle* or *great meningeal artery* is the largest branch, and arises opposite the preceding one. It ascends beneath the external pterygoid muscle, crossing the internal lateral ligament, and enters the skull through the foramen spinosum of the sphenoid bone. When in the skull the artery ends in branches which ascend to the vertex of the head, and supply the bone and the dura mater (p. 17.). Before the meningeal artery enters the skull, it furnishes the two following small branches.

branch to tympanum,

The *tympanic* branch enters the tympanum through the Glasserian fissure, and is distributed in that cavity, anastomosing with the other arterial branches of the part.

to meninges.

The *small meningeal branch* arises near the skull, and passes through the foramen ovale with the inferior maxillary nerve; it supplies the dura mater in the middle fossa of the skull.

Branches of second part are

The branches from the second part of the artery, viz. whilst it is between the muscles, are altogether muscular in their destination, and are named temporal, masseteric, buccal, and pterygoid.

to the temporal muscle;

1. The *deep temporal arteries* are two in number (anterior and posterior), and each occupies the part of the temporal fossa indicated by its name. They ascend beneath the temporal muscle, and anastomose with the superficial temporal artery. The anterior also communicates, through the malar bone, with branches of the lachrymal artery. When the parent trunk has the unusual position beneath the pterygoid, the anterior branch is beneath that muscle, instead of over it.

to the masseter;

2. The *masseteric artery* is directed outwards with the nerve of the same name behind the tendon of the temporal muscle; and passing through the sigmoid notch, enters the under surface of the masseter muscle. Its branches anastomose with the other branches to the muscle from the external carotid trunk.

to the buccinator; 3. The *buccal branch* quits the artery near the upper jaw, and in the unusual position of the artery it may perforate the fibres of the pterygoid; it then descends beneath the coronoid process with its companion nerve, and is distributed to the buccinator muscle and the side of the face, on which it joins the branches of the facial artery.

to pterygoid muscles. 4. The *pterygoid branches* are uncertain in their position; whether derived from the trunk or some of the branches of the internal maxillary, they enter the pterygoid muscles.

Branches of third part, only one now seen. Of the branches that arise from the artery when it is about to enter, or has entered the spheno-maxillary fossa, only one, the superior dental, will be now described. The remainder will be examined with the superior maxillary nerve and Meckel's ganglion (*Section* 14.); they are infraorbital, superior palatine, pterygo-palatine, spheno-palatine, and vidian.

Superior dental. 1. The *superior* or *posterior* dental branch arises near the upper maxillary bone, and descends to the teeth with a tortuous course on the outer surface of that bone, along with a small branch of the superior maxillary nerve. For the most part its offsets enter the foramina in the bone, and supply the upper molar and bicuspid teeth, but some are furnished to the gums. A few branches reach the lining membrane of the antrum.

Internal maxillary vein begins in plexus (pterygoid), The INTERNAL MAXILLARY VEIN receives the veins corresponding to the branches of the artery in the first two parts of its course. The veins of this region form a plexus — *pterygoid*, between the two pterygoid muscles, and in part between the temporal and external pterygoid muscles. This plexus communicates with the facial vein by a large branch (anterior internal maxillary); and with the cavernous sinus in the interior of the skull, by means of branches that pass through apertures in the base of the cranium. and ends in external jugular. Escaping from the plexus, the vein accompanies the artery to the parotid gland, and there joins the superficial temporal vein, — the union of the two giving rise to a vessel that enters either the external or the internal jugular vein (p. 32.).

Inferior maxillary nerve The INFERIOR MAXILLARY NERVE is the largest of the three trunks arising from the Gasserian ganglion (p. 19.), and resembles a spinal nerve in possessing fibrils that confer both motory and sensory properties on the parts to which they are distributed. consists of a motor The nerve leaves the skull by the foramen ovale in the sphenoid bone, and divides into two chief parts

and sensory part.

beneath the external pterygoid muscle; an anterior, small, or muscular part; and a large, posterior, or sensory part.

Muscular piece supplies four branches to

A. The SMALLER PART receives nearly all the fibres of the motor root of the nerve, and ends in branches to the muscles of the jaw, viz. temporal, masseteric, and pterygoid; and to one muscle of the cheek, the buccinator. Should the internal maxillary artery obstruct the view of the branches, it may be taken away.

temporal muscle; two in number,

1. The *deep temporal branches* are furnished to the under surface of the temporal muscle. Like the arteries, they are two in number, anterior and posterior. From their origin these nerves course upwards along the outer surface of the skull, and pass beneath the external pterygoid muscle.

posterior and

The *posterior branch* is the smallest, and is often derived from the masseteric nerve; it is near the back of the temporal fossa.

anterior.

The *anterior branch* supplies the greater part of the muscle, and communicates sometimes with the buccal nerve.

Masseter.

2. The *masseteric branch* takes at first a backward course above the external pterygoid muscle, and then a horizontal one, behind the temporal muscle and through the sigmoid notch, to the under surface of the masseter muscle. In the masseter the nerve can be followed to near the anterior border. As this branch passes by the articulation of the jaw it gives one or more twigs to that joint.

Branches to pterygoid muscles.

3. The *pterygoid branches* are supplied to the muscles of that name. The branch or branches to the external pterygoid enter the under surface, but the nerve to the internal pterygoid is placed on the pharyngeal aspect of this muscle close to the skull: this last, which cannot now be seen, will be learnt in the dissection of the otic ganglion (*Section* 14.).

Buccinator.

4. The *buccal branch* is longer than the others, and perforates the inner attachment of the external pterygoid; afterwards it is directed inwards, beneath the coronoid process and the temporal muscle, to the surface of the buccinator, where it ends in two terminal branches. As the nerve perforates the pterygoid muscle filaments are given to the fleshy substance; and after it has passed through the fibres, it furnishes a branch to the temporal muscle, which frequently joins the anterior deep temporal nerve. Some offsets are likewise distributed to the upper part of the buccinator muscle and to the lining mucous membrane.

This branch ends in two parts,

upper and

The *upper branch* resulting from the division reaches the upper part of the buccinator muscle, and communicates with the facial nerve around the facial vein.

lower.

The *lower branch* is in direction the continuation of the nerve.

Its offsets are inclined towards the angle of the mouth, supplying the integument, together with the buccinator muscle and the lining mucous membrane. This branch is united freely with the facial nerve, and forms a kind of plexus.

Sensory trunk of inferior maxillary. B. The LARGER PART of the inferior maxillary nerve ends in three trunks, auriculo-temporal, dental, and gustatory. Conveys a few motor fibres. A few of the fibres of the small (motor) root of the fifth are applied to this part, and are conveyed by it to certain muscles, viz. tensor tympani, circumflexus palati, and mylo-hyoideus and digastricus.

Auriculo-temporal division The AURICULO-TEMPORAL NERVE separates from the others near the base of the skull, and oftentimes has two roots. Its course to the surface of the head is first backwards lies beneath jaw, beneath the external pterygoid muscle, as far as the inner part of the articulation of the jaw; and lastly upwards with the temporal artery in front of the ear, and beneath the parotid gland. and supplies branches In this course the nerve furnishes branches to the surrounding parts, viz. to the joint, the ear, and the parotid gland, and communicates also with the facial nerve. Its ramifications on the head are described at page 8. In the part now dissected its branches are the following: —

to the meatus *a. Branches for the meatus auditorius and the articulation.*— Two offsets are directed from the point of union of the branches of the facial with the auriculo-temporal nerve to the interior of the and joint of jaw auditory meatus, between the cartilage and the bone. The branch to the articulation of the jaw is supplied from the trunk of the auriculo-temporal near the same spot, or from its branches to the meatus.

a branch to the ear, and *b.* The *inferior auricular branch* supplies the external ear below the meatus auditorius. This branch also furnishes offsets along the internal maxillary artery, which communicate with the sympathetic nerve.

parotid branches. *c. Parotid branches.*— These are small filaments that enter the substance of the gland.

to join facial and otic ganglion. *d. Branches communicating with the facial* and *sympathetic nerves.* — Two or more branches around the external carotid artery connect the auriculo-temporal with the facial nerve; and filaments to the otic ganglion arise near its beginning.

Inferior dental The INFERIOR DENTAL is the largest of the three trunks into which the inferior maxillary nerve divides, and is is between ptery- directed to the canal in the lower jaw. At first the nerve lies beneath the external pterygoid muscle, where it is

external in position to the gustatory; and is afterwards placed on the internal pterygoid, near the dental foramen, and on the internal lateral ligament. After the nerve enters the bone, it is continued forwards beneath the teeth to the foramen in the side of the jaw, and ends at that spot by dividing into an incisor and a labial branch. Only one other muscular branch (mylo-hyoid) is supplied by the dental nerve. Its branches are: —

goid muscles, and supplies teeth;

a. The *mylo-hyoid branch* arises from the trunk of the nerve as this is about to enter its foramen, and is continued along a groove on the inner aspect of the ramus of the jaw, to the cutaneous surface of the mylo-hyoideus and the anterior belly of the digastric muscle.

also branch to mylohyoideus.

b. The *dental branches* arise in the bone and supply the molar and bicuspid teeth. If the bone is soft, the canal containing the nerve and artery may be laid open so as to expose these branches.

Dental branches to grinding

c. The *incisor branch* continues the trunk of the nerve onwards to the middle line, and furnishes offsets to the canine and incisor teeth, beneath which it lies.

and cutting teeth.

d. The *labial branch* (mental?) issues on the face beneath the depressor of the angle of the mouth. At first it communicates with the facial nerve, and gives branches to the muscle covering it, as well as to the orbicularis and the integuments. But the greater part of the nerve is directed upwards, beneath the depressor labii inferioris, and is distributed on the inner and outer surfaces of the lower lip.

Branch to lower lip.

The *inferior dental artery*, after entering the lower jaw with the nerve, has a similar course and distribution. Thus it supplies dental branches to the molar and bicuspid teeth, and ends anteriorly in an incisor and a labial branch.

Dental artery has an

The *incisor branch* is continued to the symphysis of the jaw, beneath the canine and incisor teeth which it supplies, and anastomoses with the artery of the opposite side.

incisor and

The *labial branch*, after it has left the bone, ramifies in the structures covering the lower jaw, and communicates with the branches of the facial artery.

labial branch.

The GUSTATORY or LINGUAL NERVE is the remaining trunk of the inferior maxillary, and is concealed at first, like the others, by the external pterygoid muscle. It is then inclined inwards over the internal pterygoid muscle, and under cover of the side of the jaw to the tongue. The remainder of this nerve will be seen in the dissection of the submaxillary region.

Gustatory nerve courses to the tongue;

no branch here, In all this extent of the nerve there is not any branch distributed to the parts around, but the following communicating branch (chorda tympani) is received by it.

but is joined by chorda tympani. The *chorda tympani* is a branch of the facial nerve, and is distributed to the tongue. The origin of this nerve, and its course across the tympanum to its position beneath the external pterygoid, are described in *Section* 14. After issuing from the tympanum by an aperture near the Glasserian fissure, this small nerve is applied to the gustatory nerve at an acute angle. At the point of junction some fibres communicate with the gustatory, but the greater part of the chorda tympani is conducted along that nerve to the lingualis muscle. An offset is furnished from it to the submaxillary ganglion: see the subsequent *Section.*

Section VII.

SUBMAXILLARY REGION.

Parts occupying the region. The term submaxillary region is applied to the part between the lower jaw and the hyoid bone. In it will be found the small muscles acting on the os hyoides, the jaw, and the tongue; the vessels and nerves of the tongue; and the sublingual and submaxillary glands.

Position. *Position.*— In this dissection the position of the neck is the same as that for the examination of the anterior triangle.

Dissection. *Dissection.*— Directions for the cleaning of this region were given with the dissection of the anterior triangular space; but if any connective tissue has been left on the submaxillary gland, or on the mylo-hyoid muscle, let it be taken away.

Situation and connections of submaxillary gland. The *submaxillary gland* lies below the jaw in the anterior part of the space limited by that bone and the digastric muscle. Its shape is irregular, and the facial artery winds over the surface. The gland rests on the mylo-hyoideus, and sends a process round the posterior or free border of that muscle. In front of it is the anterior belly of the digastric; and behind it is the stylo-maxillary ligament separating it from the parotid. Occupying a position somewhat beneath the side of the jaw, the gland is very near the sur-

face, being covered only by the integuments and platysma, and by the deep fascia.

In structure, the submaxillary resembles the parotid gland (p. 33.); and its duct — duct of Wharton, extends beneath the mylo-hyoid muscle to the mouth.

Dissection. — The mylo-hyoid muscle may be seen by detaching the anterior belly of the digastric from the jaw, and by dislodging, without injury, the submaxillary gland from its position under the maxilla. Dissection.

The MYLO-HYOID MUSCLE is triangular in shape, with the base at the jaw and the apex at the hyoid bone, and unites along the middle line with its fellow of the opposite side. It *arises* from the mylo-hyoid ridge on the inner surface of the lower jaw as far back as the last molar tooth, and is *inserted* into the middle of the body of the hyoid bone, as well as into a central tendinous band between the jaw and that bone. On the cutaneous surface are the digastric muscle, the submaxillary gland, the facial artery with the submental offset, and its own branch of nerve and artery. Its fibres are frequently deficient near the jaw, and allow the next muscle to be seen. Only the posterior border is unattached, and round it a piece of the submaxillary gland winds. The parts in contact with the deep surface of the muscle will be perceived after the following dissection has been made. Mylo-hyoideus arises from jaw; inserted into hyoid bone. Parts around it.

Dissection. — To bring into view the muscles beneath the mylo-hyoid, and to trace the vessels and nerves to the substance of the tongue, the student should first cut through the facial vessels on the jaw, and remove them with the superficial part of the submaxillary gland, but should be careful to leave the deep part of the gland that turns beneath the mylo-hyoideus. Next he should cut through the small branches of vessels and nerve on the surface of the mylo-hyoideus; and detaching that muscle from the jaw and its fellow, should throw it down to the os hyoides, but without injuring the genio-hyoid muscle beneath it. Dissection, to detach mylo-hyoid.

Afterwards the soft parts covering the lower jaw are to be divided, and the bone is to be sawn through rather on the right side of the symphysis. The side of the jaw, which will then be loose (for the ramus of the bone has been previously cut), is to be raised to see the parts beneath; but it should neither be taken away, nor be detached from the mucous To see deep muscles

membrane of the mouth. To enable the dissector to raise upwards sufficiently this loose piece of bone, let the apex of the tongue be drawn well out of the mouth over the upper teeth, and fastened with a stitch to the septum of the nose; then let the scalpel be passed from below upwards between the cut surfaces of the bone, for the purpose of dividing a strong band of the mucous membrane of the mouth, and let it be carried onwards along the middle line of the tongue to the tip. After these directions have been followed the loose piece of the jaw can be easily turned upwards; and it is to be fastened in that position with thread.

and nerves.

By means of a hook the os hyoides may be drawn down, and the muscular fibres made tense. All the connective tissue is now to be removed, and in doing this the student is to take care of the Whartonian duct; of the hypoglossal nerve and its branches that lie on the hyo-glossus muscle; also of the gustatory nerve, nearer the jaw, with its small ganglion close to the submaxillary gland. The student should endeavour to follow the small chorda tympani nerve, which is applied to the trunk of the gustatory, onwards to the tongue, and to define the offset from it to the submaxillary ganglion. The ranine vessels, and the gustatory and hypoglossal nerves are then to be found on the under part of the tongue, and to be followed to the tip.

Parts beneath mylo-hyoid on side of neck,

Parts beneath mylo-hyoideus. — The following is the position of the objects brought into view by the steps of the previous dissection. Extending from the cornu of the hyoid bone to the side of the tongue is the hyo-glossus muscle, whose fibres are crossed superiorly by those of the stylo-glossus. On the hyo-glossus are placed, from below upwards, the hypoglossal nerve, the Whartonian duct, and the gustatory nerve, the latter crossing the duct; and near the inner border of that muscle those two nerves are united by branches. Beneath the same muscle is the lingual artery with its vein. Above the hyo-glossus is the mucous membrane of the mouth, with the sublingual gland attached to it in front, and some fibres of the superior constrictor muscle covering it behind near the jaw.

and along middle line.

Between the chin and the os hyoides, along the middle line, is the genio-hyoid muscle; and larger and deeper than this is a fan-shaped muscle, the genio-hyo-glossus. Along

the outer side of the last muscle lie the ranine vessels; and a sublingual branch for the gland of the same name springs from the lingual artery at the inner border of the hyo-glossus. On the under aspect of the tongue, near the margin, lies the gustatory nerve; and in the fibres of the genio-hyo-glossus, the hypoglossal nerve.

Hyo-glossus named from attachment; in contact with many parts.

The HYO-GLOSSUS MUSCLE is thin and somewhat square in shape. The muscle *arises* from the lateral part of the body of the os hyoides (basio-glossus), from all the great cornu of the same bone (cerato-glossus), and separately from the small cornu (chondro-glossus). The two first parts form a thin sheet, and enter the back part and side of the tongue*; they will be after seen to mingle with fibres of the palato- and stylo-glossus. The parts in contact with one surface of the hyo-glossus have been already enumerated; and those beneath the muscle are portions of both the genio hyo-glossus, and the middle constrictor, together with the lingual vessels. Along the anterior border is the genio-hyo-glossus muscle; and beneath the posterior pass the lingual artery, the glosso-pharyngeal nerve, and the stylo-hyoid ligament.

Stylo-glossus comes to side of tongue.

The STYLO-GLOSSUS is a slender muscle, whose attachments are expressed by its name. Arising from the styloid process near the apex, and from the stylo-maxillary ligament, the muscle is continued forwards to the side of the tongue. Here it gives fibres to the dorsum, and crossing the preceding turns to the under surface, and extends to the tip of the tongue. Beneath the jaw this muscle is crossed by the gustatory nerve.

Genio-hyoideus along middle line of neck.

The GENIO-HYOID MUSCLE *arises* from the lower of the two lateral tubercles on the inner aspect of the symphysis of the jaw, and is *inserted* into the middle of the hyoid bone. Covered by the mylo-hyoideus, this muscle rests on the genio-hyo-glossus. The inner border is close to its fellow of the opposite side, and the two are often united.

Genio-hyo-glossus

The GENIO-HYO-GLOSSUS is the largest muscle of this region; it has a triangular form, the apex being at the jaw,

* The third part (chondro-glossus) is distinct from the others, and ends on the upper surface of the tongue near the root; but for further detail respecting the anatomy of this and the other lingual muscles, reference is to be made to the dissection of the tongue, *Section* 15.

and the base at the tongue, and is in contact along the middle line with the corresponding muscle of the other side. It takes *origin* from the upper tubercle behind the symphysis of the jaw. From this spot the fibres radiate, the posterior passing downwards to their insertion into the body of the hyoid bone, the anterior forwards to the tip of the tongue, and the intermediate to the whole length of the tongue, from root to point. Lying along the middle of the tongue, it is in contact with its fellow; whilst the lower border of the muscle corresponds to the genio-hyoideus, and the upper to the frænum linguæ. On its outer side are the ranine vessels, and the hyo-glossus muscle; and the hypoglossal nerve perforates the posterior fibres.

connected with chin, hyoid bone, and tongue.

Contiguous parts.

Lingual artery ascends to the tongue beneath hyo-glossus.

The *lingual artery* is one of the anterior branches of the external carotid, and arises between the superior thyroid and facial branches. At first it is directed inwards above the os hyoides, but is afterwards inclined slightly upwards beneath the hyo-glossus to the under part of the tongue, and ends at the anterior border of that muscle in the sublingual and ranine branches. Before reaching the hyo-glossus the artery is superficial, though it is crossed near that muscle by the ninth nerve, and by the digastric and stylo-hyoid muscles. Beneath the hyo-glossus, the vessel rests on the middle constrictor and genio-hyo-glossus muscles, and is situate below the level of the glosso-pharyngeal nerve. Its *branches* are these:—

Its branches are—

to hyoid bone;

A small *hyoid branch* is distributed on the upper border of the os hyoides, where it anastomoses with the one of the opposite side, and with the hyoid branch of the superior thyroid artery.

to back of the tongue;

A *branch to the dorsum of the tongue* arises beneath the hyo-glossus muscle, and ascends to supply the substance of that organ. The fibres of the hyo-glossus must be divided to see it.

to the sublingual gland;

The *sublingual branch* springs from the final division of the artery at the edge of the hyo-glossus, and is then directed outwards to the gland from which it takes its name. Some offsets supply the gums and the mylo-hyoid muscle, and one continues behind the incisor teeth to join a similar artery from the other side.

to the substance of tongue.

The *ranine branch* is the terminal part of the lingual artery, and extends forwards along the outer side of the genio-hyo-glossus to the tip of the tongue where it ends: it

anastomoses with the artery of the other side of the body. Muscular offsets are furnished to the substance of the tongue. This artery corresponds to the frænum linguæ, near the tip of the tongue, but lies close to the muscular fibres. This lies along frænum.

The *lingual vein* commences both on the upper and under surfaces of the tongue. It lies with its companion artery, and ends in the internal jugular vein. Lingual vein.

The GUSTATORY OR LINGUAL NERVE has been followed in the examination of the pterygo-maxillary region to its passage between the ramus of the lower jaw and the internal pterygoid muscle. In this dissection the nerve is seen to be inclined forwards to the side of the tongue, over the mucous membrane of the mouth and the origin of the superior constrictor muscle, and above the deep part of the submaxillary gland. Lastly, the nerve is directed across the Whartonian duct, and along the side to the apex of the tongue. In this region the gustatory nerve is separated altogether from the cavity of the mouth by the layer of mucous membrane. *Branches* are furnished to the surrounding parts, thus:— Lingual nerve along side of tongue gives branches

Two or more branches connect it with the submaxillary ganglion, near the gland of that name. to the ganglion

Farther forwards branches descend on the hyo-glossus to unite in a kind of plexus with twigs of the hypoglossal nerve. to ninth nerve,

Other filaments are supplied to the mucous membrane of the mouth and the gums, and to the sublingual gland. to mucous membrane,

Lastly the *branches for the tongue* ascend through the muscular substance, and are distributed as well to the conical and fungiform papillæ. to the papillæ.

Submaxillary ganglion. — Closely connected with the gustatory nerve is this little ganglion, which resembles the other ganglia connected with the three trunks of the fifth nerve, since it communicates with sensory, motory, and sympathetic nerves. It is a small reddish body, about the size of the lenticular ganglion, and is placed above the deep process of the submaxillary gland. Offsets proceed upwards to connect it with other nerves, and from the lower part arise the branches that are distributed to the adjacent structures. Submaxillary ganglion; nature;

Connection with nerves — roots.— Two or three branches, in the form of loops, pass from the ganglion to the gustatory nerve. At the posterior part, the ganglion is further joined by an offset from the chorda tympani (of the facial nerve) which lies in contact with joins gustatory, facial, and sympathetic nerves.

the gustatory. And its sympathetic branch comes from the nerves around the facial artery.

Branches. *Branches.*— From the lower part of the ganglion five or six branches descend to the substance of the submaxillary gland; and from the anterior part other filaments are furnished to the mucous membrane of the mouth and to the Whartonian duct.

Ninth nerve, between the chin and hyoid bone The HYPO-GLOSSAL or NINTH NERVE, after crossing the side of the neck and the anterior triangle (p. 82.), enters between the small muscles of the submaxillary region. Here the nerve lies on the hyo-glossus muscle, being concealed by the mylo-hyoideus: but at the inner border of the hyo-glossus it enters the fibres of the genio-hyo-glossus, and is continued is lost in middle of tongue. along the middle line of the tongue to the apex. The position of the ninth nerve is in the centre of the tongue, whilst the gustatory lies near the margin: the ninth supplies branches to the muscular structure, and the gustatory ends chiefly in the papillæ.

Its branches supply muscles *Branches.*— On the hyo-glossus the ninth nerve furnishes branches to the muscles of the submaxillary region, except the mylo-hyoid and the digastric, viz., to the hyo-glossus, stylo-glossus, genio-hyoideus, and genio-hyo-glossus. Further, some offsets ascend on the hyo-glossus to communicate with the gustatory nerve. Along the middle of the tongue the nerve sends upwards long filaments with the branches of the ranine artery, that supply the and the tongue. structure of the tongue, and communicate with the gustatory nerve.

Wharton's duct The *duct of the submaxillary gland*, or Wharton's duct, issues from the deep part of the glandular mass that turns round the border of the mylo-hyoid muscle. It is about two inches in length, and is directed upwards on the hyo-glossus opens by frænum linguæ. muscle, and beneath the gustatory nerve, to open on the side of the frænum linguæ in the centre of an eminence. The duct consists of three coats,— an external thin and fibrous, a Structure. middle or muscular, and an internal or mucous; and its opening in the mouth will be seen if a bristle be passed along it. This is the only salivary duct, according to Professor Kölliker, that possesses a stratum of muscular fibre. The deep part of the submaxillary gland extends, in some instances, even to the sublingual gland.

Sublingual gland The *sublingual gland* is somewhat of the shape of an almond, and the longest measurement, which is about one

inch and a half, is directed backwards. It is situate beneath the anterior part of the tongue, in contact with the inner surface of the lower jaw, close to the symphysis. Separated from the cavity of the mouth by the mucous membrane, the gland is prolonged across the upper border of the genio-hyo-glossus muscle, so as to touch the one of the opposite side. is beneath tongue.

The sublingual resembles the other salivary glands in its composition (p. 33.). The ducts of the lobules — ductus Riviniani — are from eight to twenty in number, of which some open beneath the tongue along a crescentic shaped fold of the mucous membrane; others join the Whartonian duct; and one or more form a larger tube, which either joins that duct or opens near it. Structure. Ducts open in mouth.

Section VIII.

SUPERIOR MAXILLARY NERVE AND VESSELS.

The remaining trunk of the fifth nerve, viz. superior maxillary, may be learnt conveniently after the dissection of the pterygo-maxillary and submaxillary regions. Superior maxillary nerve next.

Dissection. — The superior maxillary division of the fifth nerve, in its course to the face, occupies successively the skull, the spheno-maxillary fossa, and the infra-orbital canal; and to lay bare the nerve in its whole extent the skull, the fossa, and the orbit must be opened. The skull and the orbit will have been already opened, if the preceding instructions have been followed; but if the latter has not been dissected, refer to the necessary steps (p. 43.). Dissection.

To trace the nerve in the spheno-maxillary fossa, the student may make the following dissection: — The middle fossa of the base of the skull is to be cut through from the inside with a chisel; the cut is to be made from the sphenoidal fissure in front to the foramen spinosum behind, and external to the foramen rotundum and foramen ovale. The side of the skull is then to be sawn through vertically in front of the petrous part of the temporal bone, so that the incision shall end at the posterior extremity of the cut made in the base. Afterwards, with a bone forceps or a saw the outer wall of the orbit is to be divided into the spheno-max- In spheno-maxillary fossa.

illary fissure. The piece of bone forming part of both the skull and orbit is now loose, and is to be removed with the temporal muscle. The nerve can be partly seen as it crosses the spheno-maxillary fossa; but to bring it more completely into view, some of the sphenoid bone bounding the fossa must be taken away, so as to leave only an osseous ring round the nerve at its exit from the skull. In the fat of the fossa the student is to seek the following offsets,—the orbital branch, branches to Meckel's ganglion, and dental branches to the upper jaw.

In floor of orbit. To follow onwards the nerve in the floor of the orbit, the contents of the cavity must be away, and the bony canal in which it lies must be opened even to the face. Near the front of the orbit the anterior dental branch is to be traced downwards for some distance in the bone. The infraorbital vessels are to be prepared with the nerve.

Upper maxillary nerve passes to face, through infra-orbital canal, where it ends. The SUPERIOR MAXILLARY NERVE commences in the Gasserian ganglion (p. 19.), and leaves the cranium by the foramen rotundum. The course of the nerve is then almost straight to the face, along the orbital plate of the superior maxilla. Outside the cranium the nerve is first placed across the spheno-maxillary fossa, and it afterwards enters the infraorbital canal. Issuing from the canal by the infraorbital foramen, the nerve is concealed by the elevator of the upper lip, and ends in branches to the eyelid, nose, and upper lip. It furnishes the following branches:

Its branches are to orbit; 1. The *orbital branch* arises in the spheno-maxillary fossa, and enters the orbit through the fissure of the same name; it divides into a malar and a temporal branch (see p. 52.).

to the nose and palate; 2. The *spheno-palatine branches* descend from the nerve in the fossa, and supply the nose and palate: these are connected with Meckel's ganglion, and will be dissected with it.

to the teeth and buccinator; 3. Two *posterior dental branches* leave the trunk of the nerve near the upper jaw. One is distributed to the gums and the buccinator muscle. The other enters a canal in the upper maxilla, and supplies branches to the molar teeth and the lining membrane of the antrum; it joins the anterior dental branch soon after entering the bone, and again near the teeth.

to anterior teeth. 4. The *anterior dental branch* quits the trunk of the nerve in the floor of the orbit, and descends to the anterior teeth in a special canal in front of the antrum. It is distributed by two branches. One (the inner) gives filaments to the incisor and canine teeth,

and furnishes, moreover, one or two filaments to the lower meatus of the nose; the other (outer) ends by supplying the bicuspid teeth.

5. Before the nerve ends in the facial branches, it supplies a small *palpebral branch* to the lower eyelid; this is directed upwards to the lid in a groove in the margin of the orbit. Branch of eyelid.

6. *Infraorbital or facial branches.*— These are larger than the other offsets of the nerve, and form its terminal ramifications. Some incline inwards to the side of the nose, and the rest descend to the upper lip. These branches are crossed near the orbit by branches of the facial nerve, with which they communicate, the whole forming the *infraorbital plexus* (p. 42.). Infra-orbital branches join facial nerve, and supply the

a. The *branches to the side of the nose* supply the muscular and tegumentary structures. nose

b. The *branches to the upper lip* are three or four in number, and are distributed chiefly to the surfaces of the lip, though they supply as well the labial glands and the muscles. and upper lip.

The *infraorbital artery* is one of the terminal branches of the internal maxillary artery in the spheno-maxillary fossa, and accompanies the superior maxillary nerve. Taking the course of the nerve through the infraorbital canal, the vessel appears in the face beneath the elevator muscle of the upper lip; and ends in branches, which are distributed, like those of the nerve, to the portion between the eye and the mouth. In the face its branches anastomose with the facial and buccal arteries. Infra-orbital artery ends in face;

In the canal in the upper maxilla this artery furnishes branches to the orbit. has a branch to orbit,

Another branch, *anterior dental*, runs with the nerve of the same name, and supplies the incisor and canine teeth. This gives branches to the antrum of the maxilla, and near the teeth it anastomoses with the posterior dental artery. and one to anterior teeth.

The *vein*, accompanying the artery, communicates in front with the facial vein; and behind, with a plexus of veins corresponding with the branches of the internal maxillary artery in the spheno-maxillary fossa. Infra-orbital vein.

SECTION IX.

DEEP VESSELS AND NERVES OF THE NECK.

Parts in this section. IN this Section are included the deepest styloid muscle, the internal carotid and ascending pharyngeal arteries, and the eighth, ninth, and sympathetic nerves.

Position. *Position.* — The position of the part is to remain still the same, viz. the neck is to be fixed over a small block.

Dissection of the stylo-pharyngeus. *Dissection.* — To see the remaining styloid muscle, the posterior belly of the digastric, and the stylo-hyoid muscle should be detached from their origin, and thrown down. At this stage, a filament of the facial nerve may be sometimes seen to perforate the digastric muscle, and join the glosso-pharyngeal nerve beneath. The trunk of the external carotid artery is to be removed by cutting it through where the hypoglossal nerve crosses it, and by dividing those branches that have been already examined, as well as, if it is necessary, the veins accompanying the arteries. Glosso-pharyngeal nerve. In cleaning the surface of the stylo-pharyngeus muscle, the glosso-pharyngeal nerve and its branches may be prepared. The side of the jaw is still to remain turned upwards, as in the dissection of the submaxillary region.

Stylo-pharyngeus. The STYLO-PHARYNGEUS MUSCLE resembles the other styloid muscles in its elongated form. The fibres *arise* from Origin. the root of the styloid process on the inner surface, and descend, between the superior and middle constrictors, to be Insertion. *inserted* partly into the pharynx, and partly into the upper border of the thyroid cartilage. Is between carotid arteries. The muscle lies below the stylo-glossus, and between the carotid arteries ; and the glosso-pharyngeal nerve turns over the lower part of its fleshy belly.

Stylo-hyoid ligament The *stylo-hyoid ligament* is a fibrous band, that extends from the tip of the styloid process to the small cornu of the os hyoides. lies by side of preceding. Its position is between the stylo-glossus and stylo-pharyngeus muscles, and over the internal carotid artery, whilst the lower end is beneath the hyo-glossus muscle. To the posterior border the middle constrictor muscle is attached. It is frequently cartilaginous or osseous in part of, or in all its extent.

The INTERNAL CAROTID ARTERY supplies parts within the head, viz. the brain and the eye and its appendages, and takes a circuitous course through, and along the base of the skull before it terminates in the brain. Internal carotid artery.

Dissection.— The part of the arterial trunk in the base of the skull, and its offset to the orbit, have been already examined, but the part in the neck and the temporal bone remains to be dissected. Its branches to the brain are described with the encephalon. Some parts already seen.

For the display of the cervical part of the artery there is now but little dissection required, since by detaching the styloid process at the root, and throwing it with its attached muscles to the middle line, the internal carotid artery and the jugular vein may be followed upwards to the skull. Only a dense fascia now conceals them, which is to be taken away carefully, so that the branches of the eighth and ninth nerves, that are in contact with the vessels near the base of the skull, may not be injured. In the fascia, and superficial to the artery near the skull, are the pharyngeal branch of the vagus, and the glosso-pharyngeal nerve and its branches; whilst the superior laryngeal branch of the vagus is beneath the carotid. Between the vein and artery, also near the skull, are the vagus, hypoglossal, and sympathetic nerves; and crossing backwards, over or under the vein, the spinal accessory nerve. External to the position of the vessels will be found a loop of the first and second cervical nerves, over the transverse process of the atlas, which communicates with the large ganglion of the sympathetic beneath the artery, and with the eighth and ninth nerves. Ascending to the cranium, on the inner side of the carotid, is the ascending pharyngeal artery. Dissection of carotid in the neck;

To open the carotid canal in the temporal bone, and to follow the contained artery into the cranium, make a cut down the side of the skull in the following manner: — the saw being placed behind the mastoid process, cut forwards to the foramen spinosum in the wing of the sphenoid bone (to which spot the side of the skull has been already taken away), and let the instrument be directed through the stylo-mastoid foramen and the root of the styloid process, but rather external to the jugular foramen and the carotid canal. When the piece of detached bone has been taken away, the in the temporal bone.

carotid canal may be opened with the bone forceps. In dissecting the artery in the canal, large and rather red branches of the superior cervical ganglion of the sympathetic will be found on it; and with care two small filaments may be recognised, — one from Jacobson's nerve, joining the sympathetic at the posterior part of the canal; the other from the vidian nerve, at the front of the canal.

Piece of tympanum obtained.

On the piece of bone that has been cut off, the dissector may prepare very readily the tympanum with its membrane, chain of bones, and chorda tympani nerve.

Internal carotid enters the skull.

The *internal carotid artery* springs from the bifurcation of the common carotid trunk, and extends from the upper border of the thyroid cartilage to the base of the skull; then through the petrous portion of the temporal bone; and lastly along the base of the skull to the anterior clinoid process, where it ends in branches for the brain. This winding course of the artery may be divided into three parts: — one part in the neck, another in the temporal bone, and a third inside the skull.

Its course is first through the neck

Cervical part. — In the neck the artery ascends almost vertically from its origin to the carotid canal, and is in contact with the pharynx on its inner side. Its depth from the surface varies as in the external carotid; and the line of the digastric muscle may be taken as the index of this difference. Thus, below that muscle, the internal carotid is contained in the anterior triangular space, being overlapped by the sterno-mastoid, and covered by the common teguments, fascia, and platysma, and is on the same level as the external carotid, though behind it. But, above that muscle, the vessel is placed deeply beneath the external carotid artery and the parotid gland, and is crossed by the styloid process and the stylo-pharyngeus muscle, by the glosso-pharyngeal nerve and its branches, and by the pharyngeal branch of the vagus nerve. Whilst in the neck the internal carotid lies on the rectus capitis anticus major muscle, which separates it from the vertebræ, also on the superior laryngeal and sympathetic nerves. Accompanying the artery is the internal jugular vein, which is placed on the outer side; and between the two vessels is the pneumo-gastric nerve. This part of the artery remains much the same in size to the end, and usually does not furnish any branch.

where it is superficial below, but deep above; resting on longus colli, with internal jugular vein and vagus.

Part in the temporal bone. — In the carotid canal the tortuous course of the vessel commences. Following the winding of its canal, the artery first ascends in front of the inner ear (cochlea and tympanum); next it is directed forwards almost horizontally; and lastly it turns upwards into the cranium opposite the foramen lacerum (basis cranii). Branches of the sympathetic nerve surround the carotid in the temporal bone. Second part in temporal bone. Surrounded by sympathetic.

The *cranial part* of the artery is described with the base of the skull (see p. 22.). Third part.

Peculiarities in the carotid.— The length of the internal carotid vessel varies in a given number of bodies, both from difference in the length of the neck, and in the point of division of the common carotid trunk. The course of the vessel may be very tortuous, instead of being straight. It has been already said (p. 80.), that the internal carotid may arise sometimes from the arch of the aorta. Further, this vessel may be absent from the neck: in such case the common carotid may take its place, and give the usual offsets of the external carotid. In one instance (Quain) where the artery was deficient in the neck, two branches of the internal maxillary entered the skull, and formed by their union a substitute for it in the cranium. Peculiarities in length, direction, and origin. Absence.

The INTERNAL JUGULAR VEIN is continuous with the lateral sinus of the skull, and extends from the foramen jugulare to the sterno-clavicular articulation. At the lower part of the neck it has been seen to join the subclavian, to form the innominate vein (p. 80.). As far as the thyroid cartilage this vein accompanies the internal carotid, but below that point it is with the common carotid artery; and it lies on the outer side of each. Its contiguity to the artery is not equally close in all its extent, for near the skull there is a small interval between them, containing the eighth and ninth nerves; and at the lower part of the neck there is a still larger intervening space, in which the pneumogastric nerve is found. The size of the vein remains much the same till near the os hyoides, where it is suddenly increased by the addition of those branches of the head and neck, corresponding with branches of the external carotid artery, that do not join the external jugular vein. The following branches open into the internal jugular, viz. the facial, lingual, thyroid (superior), occipital, and pharyngeal; and Internal jugular vein joins inferiorly subclavian. Is on outside of carotids, and is joined by branches below os hyoides.

at the lower part of the neck it receives the middle thyroid vein. Near its junction with the subclavian below are two valves.*

Valves.

Sometimes the term *internal cephalic* is applied to the vein between the skull and the hyoid bone; whilst that of *internal jugular* is given to the part below the bone, and the junction of the large branches at that spot.

Ascending pharyngeal artery

The *ascending pharyngeal artery* is a long slender branch of the external carotid, which arises near the commencement of that vessel. Directed upwards on the spinal column, between the internal carotid and the pharynx, the artery becomes tortuous near the skull, and divides into branches for the pharynx and the cranium. In the neck the artery gives some small offsets to the surrounding parts, viz. the muscles on the vertebræ, the nerves, and the lymphatic glands; and other branches anastomose with the ascending cervical artery.

ends near skull, in

a branch to meninges,

The *meningeal branch* enters the cranium through the foramen lacerum (basis cranii), and is distributed on the meninges of the middle fossa of the skull.

and another to pharynx and palate.

The *pharyngeal branch*, which is larger than the preceding, turns inwards to the pharynx, and dividing into several twigs, supplies the muscular structure of the pharynx, the soft palate, and the Eustachian tube. The size of the *palatine* branch depends upon that of the inferior palatine branch of the facial artery: it courses above the upper constrictor, and ends in branches that are distributed on the front and back of the soft palate, beneath the mucous membrane.

Its vein.

The *vein* corresponding with the pharyngeal artery receives branches from the cranium and the pharynx, and ends in the internal jugular vein.

Directions concerning eighth nerve.

Dissection of the eighth nerve. — By the time the student has arrived at this stage of the dissection, it will not be possible for him to trace the very minute filaments of the eighth nerve in the foramen jugulare of the skull. The student is therefore recommended to omit, for the present, all the paragraphs marked with an asterisk. Afterwards, if a fresh piece of the skull can be obtained, in which the nerves

* Anatomical and Physiological Observations by John Struthers, M.D. Edinburgh, 1854.

have been hardened by spirit, and the bone softened by acid, he may return to the examination of the parts that are now passed over.

* *In the foramen lacerum.* — Supposing the dissection of the internal carotid to be made as it is described at page 109., let the student cut across with care the jugular vein near the skull, and the internal carotid, if it is necessary. Let him then remove, bit by bit, with the bone forceps, or with a scalpel if the part has been softened, the ring of bone that bounds externally the jugular foramen, proceeding as far forwards as the crest of bone between the foramen and the aperture of the carotid canal. Between the ring of bone and the coat of the jugular vein, is the small auricular branch of the pneumo-gastric nerve, which is directed backwards to an aperture near the styloid process.

Dissection to open jugular foramen.

* First trace the pneumo-gastric and spinal accessory nerves through the canal, by opening the fibrous sheath that surrounds them. On the pneumo-gastric is a small ganglion, from which filaments are to be sought passing to the smaller portion of the spinal accessory nerve, and to the ascending branch of the upper cervical ganglion of the sympathetic; the auricular branch, before referred to, also takes origin from this ganglion. Two parts, large and small, of the spinal accessory nerve should be defined: the latter is to be shown joining the ganglion of the vagus, and then applying itself to the trunk of that nerve. A communication also exists between the two parts of the spinal accessory.

Follow pneumo-gastric and spinal accessory and their branches;

* Next follow the glosso-pharyngeal nerve through the foramen, and take away any bone that overhangs it. This nerve presents two ganglia, as it passes from the skull: one (jugular), that is scarcely to be perceived, near the upper part of the tube of membrane that contains it; the other, much larger (petrous), is placed at the lower border of the petrous portion of the temporal bone. From the lower one, seek a filament of communication with the sympathetic in the neck; also Jacobson's nerve, that enters an aperture in, or on one side of the crest of bone between the jugular foramen and the carotid canal. Sometimes there will exist a filament from the lower ganglion to join the auricular branch of the pneumo-gastric, and another to end in the upper ganglion of the pneumo-gastric nerve.

afterwards, glosso-pharyngeal and its branches.

Dissection of the nerves in the neck.

Below the foramen of exit from the skull, the eighth nerve has been sufficiently denuded, by the dissection of the internal carotid, to examine its branches in the neck, with the exception of the inferior laryngeal nerve. But the connections between the eighth, ninth, sympathetic, and first two spinal nerves should be traced out near the skull. Taking the pneumo-gastric nerve, it will be found to swell into a large oval body (lower ganglion), which is closely united with the hypoglossal, and is connected by branches with the other nerves. The hypoglossal nerve communicates also with the sympathetic and the spinal nerves. Lastly the student should trace the recurrent branch of the vagus from the lower part of the neck to the larynx.

Eighth nerve

The EIGHTH CRANIAL NERVE (Willis) consists of three distinct trunks, viz. glosso-pharyngeal, pneumo-gastric, and spinal accessory, which leave the cranium by the foramen jugulare (p. 21.). Outside the skull these nerves take different directions according to their destination; thus the glosso-pharyngeal is inclined inwards to the tongue and pharynx; the spinal accessory passes backwards to the sterno-mastoid and trapezius muscles; and the pneumo-gastric nerve descends to the viscera of the thorax and abdomen.

consists of the three following trunks:

Glosso-pharyngeal nerve;

The GLOSSO-PHARYNGEAL NERVE is the smallest of the three trunks, and in the jugular foramen is placed somewhat in front of the other two; it lies in a groove in the lower border of the petrous part of the temporal bone. In the aperture of exit, the nerve is marked by two ganglionic swellings, the upper one being the jugular, and the lower one the petrous ganglion.

has two ganglia in foramen lacerum,

Its upper

Ganglia. — The *jugular ganglion* (gang. superius) is of very small size, and is situate at the upper part of the osseous groove that contains the nerve. It is placed at the outer aspect of the glosso-pharyngeal trunk, and includes only some fibrils of the nerve. The *petrosal ganglion* (gang. inferius), is much larger than the preceding, and encloses all the fibrils of the nerve. This ganglion is placed in a hollow in the lower border of the temporal bone, and from it arise the branches that unite the glosso-pharyngeal with the other nerves.

and lower ganglion.

After the nerve has quitted the foramen, it comes forwards between the jugular vein and the carotid artery, and crossing inwards over the artery, reaches the lower border of the stylo-pharyngeus muscle. At this spot, the nerve becomes almost transverse in direction in its course to the pharynx; it passes over the stylo-pharyngeus, and forms an arch across the side of the neck (p. 66.), above the superior laryngeal nerve. Finally the nerve enters beneath the hyo-glossus muscle, and ends in branches to the pharynx, the tongue, and the tonsil.

In the neck, courses to the tongue and pharynx.

The *branches* of the glosso-pharyngeal may be classed into those connecting it with other nerves at the base of the skull, and those that are distributed in the neck.

Branches to join

Connecting branches. — These arise chiefly from the petrosal ganglion, and in this set is the tympanic nerve.

with others, viz.

1. * A *filament* ascends from the *sympathetic nerve* in the neck to join the petrosal ganglion. Sometimes there is a filament given from this ganglion to the auricular branch of the vagus, as well as to the upper ganglion of that nerve.

sympathetic and vagus,

2. * The *tympanic branch* (nerve of Jacobson) enters the aperture in the ridge of bone between the jugular and the carotid foramen, and ascends by a special canal to the inner wall of the tympanum, where it ends in branches. Its distribution is given with the anatomy of the tympanum of the ear.

facial and sympathetic by this branch,

3. *Connecting branch of the facial nerve.* — This pierces the digastric muscle, and joins the trunk of the glosso-pharyngeal, below the petrosal ganglion: it is not always present.

and with facial;

Branches for Distribution.—In the neck the branches are furnished chiefly to the tongue and the pharynx, but they are also united with other nerves.

distributed to

1. *Carotid branches* surround the artery of that name, and communicate on it with the pharyngeal branch of the vagus, and with the sympathetic nerve.

carotid artery,

2. Some *muscular branches* enter the stylo-pharyngeus, whilst the nerve is in contact with it.

stylo-pharyngeus,

3. *Branches to the pharynx* form the pharyngeal plexus by uniting with nerves from the sympathetic and vagus.

and pharyngeal plexus,

4. The *tonsillitic branches* supply the tonsil and the arches of the soft palate. On the former they end in a kind of plexus — circulus tonsillaris.

the tonsil,

5. *Lingual branches.*—The terminal branches of the nerve supply the root and the posterior part of the tongue, as well as the

and the tongue.

lateral surface. The distribution of these is described with the tongue (*Section* 15.).

Vagus nerve

The PNEUMO-GASTRIC NERVE (vagus nerve) is the largest of the three trunks of the eighth cranial nerve (Willis), and occupies the same sheath of dura mater as the spinal accessory in the jugular foramen. In the foramen it has a distinct ganglion (gang. of the root), to which the smaller part of the spinal accessory nerve is connected.

in foramen jugulare,

When the nerve has escaped from the foramen, it receives the small part of the spinal accessory, and swells into a large ganglion (gang. of the trunk). Here the nerve lies between the carotid artery and the jugular vein, and communicates with the several nerves at this part. To reach the thorax, the vagus descends, almost vertically, between the internal jugular vein and the internal and common carotid arteries, and enters that cavity, on the right side, by crossing over the subclavian artery.

and in the neck,

courses to the thorax.

One ganglion in foramen,

Ganglia.—The *ganglion of the root* (gang. superius) is of a greyish colour, and in texture is like the ganglion on the large root of the fifth nerve. The small branches of the vagus in the foramen jugulare come from this ganglion. The *ganglion of the trunk* (gang. inferius) is cylindrical in form, is reddish in colour, and is nearly an inch in length. It communicates with the hypoglossal, spinal, and sympathetic nerves. All the intrinsic fibres of the trunk of the nerve are surrounded by the ganglionic substance, but those derived from the spinal accessory nerve pass by the ganglion without being inclosed in it.

another below.

Branches

The same arrangement may be made of the *branches* of the pneumo-gastric in the neck, as was adopted for the branches of the glosso-pharyngeal, viz. into those uniting it with other nerves, and those that are distributed to the parts around.

to unite with others;

Connecting Branches.— Branches of communication arise from both the ganglion of the root and that of the trunk of the nerve.

spinal accessory, sympathetic, glosso-pharyngeal;

* *a. From the ganglion of the root.*— One or two short filaments unite this ganglion with the spinal accessory nerve, and a branch of the sympathetic nerve in the neck enters the ganglion. Occasionally there is an offset to join the lower (petrosal) ganglion of the glosso-pharyngeal nerve. Its chief branch is the following.

* The *auricular branch* traverses the substance of the temporal bone, and reaches the outer ear, on which it is distributed. This little nerve arises from the ganglion, and crosses the jugular fossa to enter an aperture near the root of the styloid process. Its farther course to the outer ear will be described with the anatomy of the ear. auricular branch;

* *b. From the ganglion of the trunk.*—This ganglion is connected intimately with the hypoglossal nerve. Other branches pass between it and the upper ganglion of the sympathetic, and between it and the loop of the first two cervical nerves. with ninth, sympathetic, spinal nerves.

Branches for Distribution. — These branches arise from the inner side of the nerve, and are directed to the middle line of the body, to supply the pharynx, the larynx, and the heart. Branches to supply

1. The *pharyngeal branch* is an offset from the upper part of the ganglion of the trunk of the pneumo-gastric, and terminates, as the name expresses, in the pharynx. The nerve is directed inwards over the internal carotid artery, and joins the branches of the glosso-pharyngeal nerve on that vessel. Finally it courses to the side of the middle constrictor muscle, and communicates with branches of the glosso-pharyngeal, superior laryngeal, and sympathetic nerves, to form the *pharyngeal plexus* of the same side. This plexus is opposite the middle constrictor, and branches are furnished by it to the muscles, and to the pharyngeal mucous membrane between the tongue and the hyoid bone. pharynx and join glosso-pharyngeal and pharyngeal plexus.

2. The *superior laryngeal nerve* is much larger than the preceding branch, and arises from the middle of the ganglion of the trunk of the vagus. From this spot the nerve inclines obliquely inwards, beneath the internal carotid artery, and reaches the larynx opposite the interval between the hyoid bone and the thyroid cartilage. The nerve then perforates the thyro-hyoid membrane, and is distributed to the mucous membrane of the larynx. (See "Larynx.") In the neck it furnishes branches to the thyroid body, and the following offset to one laryngeal muscle. To enter larynx, and supply it and

The *external laryngeal branch* arises in the neck beneath the internal carotid artery. Taking a course similar to that of the superior laryngeal nerve, but below it, this branch reaches the side of the larynx, and gives offsets to the pharyngeal plexus. Finally, the nerve is continued beneath the sterno-thyroideus, to supply the crico-thyroid muscle and the thyroid body. Near its origin this branch communicates with the sympathetic nerve (superficial cardiac branch). a branch outside larynx to crico-thyroid, and thyroid body.

3. *Cardiac branches.*— Some small cardiac nerves arise from the pneumo-gastric at the upper part of the neck, and join cardiac Branches to the heart.

at upper and lower part of neck. branches of the sympathetic. At the lower part of the neck, on each side, there is a single cardiac nerve: — that of the right side enters the chest, and joins one of the deep nerves to the heart from the sympathetic; and on the left side the corresponding nerve terminates in the superficial cardiac plexus of the thorax.

Another branch to larynx, ends in muscles in interior. 4. The *inferior laryngeal* or recurrent nerve of the right side leaves the pneumo-gastric trunk opposite the subclavian artery, and winding round that vessel, takes an upward course in the neck to the larynx. To reach its destination, the nerve ascends beneath the common carotid and inferior thyroid arteries, and then between the trachea and the œsophagus. At the larynx it enters beneath the ala of the thyroid cartilage, and it will be afterwards traced into the interior. The following branches arise from it: —

It has branches to heart, *a.* Some *cardiac branches* leave this nerve as it turns round the subclavian artery; these enter the thorax, and join the cardiac nerves of the sympathetic.

to trachea, and œsophagus. *b. Muscular branches* spring from the recurrent nerve whilst it lies between the trachea and the œsophagus, and are distributed to both those tubes. Near the larynx also some filaments are furnished to the inferior constrictor muscle.

Left recurrent nerve. On the left side of the body the recurrent nerve arises in the thorax, opposite the arch of the aorta, around which it bends. In the neck its position is between the trachea and the œsophagus, as on the right side.

Spinal accessory has two parts The SPINAL ACCESSORY NERVE passes through the foramen jugulare with the pneumo-gastric, but is not marked by any ganglion while in the foramen. This nerve is constructed of two parts, viz. accessory to the vagus, and spinal, which have different origins and distributions. See Origin of the cranial nerves.

accessory to vagus in foramen. The part *accessory to the vagus* is the smaller of the two, and finally blends with the vagus beyond the skull. In the foramen of exit from the skull, it lies close to the vagus; and here it joins the upper ganglion of that nerve by one or two filaments.

Below foramen; how ends. Having passed through the foramen, this part is applied to the vagus; it is then continued over the lower ganglion of that nerve, and blends with the trunk of the vagus only beyond the ganglion. It gives offsets to join the pharyngeal and upper laryngeal branches of the vagus; and according to Bendz, offsets from it may be traced into many other branches of the same nerve.

The *spinal* part is much larger, is round and cord-like, and is connected with the smaller piece, whilst it is passing through the foramen jugulare. Spinal part in foramen.

Beyond the foramen the nerve takes a backward course through the sterno-mastoid muscle, and across the side of the neck to the trapezius muscle. At first it is somewhat concealed by the jugular vein, but it then passes either over or under that vessel, to take the course above indicated. The connections of the nerve beyond the sterno-mastoideus have been already examined (p. 59.). In the neck, crosses to trapezius.

This nerve furnishes muscular offsets to the sterno-mastoideus and the trapezius. Supplies muscles.

The HYPOGLOSSAL NERVE (ninth of Willis), after passing from the cranium by the anterior condyloid foramen, lies deeply beneath the internal carotid artery and the jugular vein. It then comes forwards between the vein and the artery, turning round the outer side of the vagus, to which it is intimately united. The nerve next descends in the neck, and becomes superficial below the digastric muscle in the anterior triangular space. From this spot the nerve is directed inwards to the tongue and its muscles. Ninth nerve crosses inwards to tongue.

The *branches* of this nerve are furnished to the muscles on the fore part of the neck, and to the muscular substance of the tongue; but there are also some branches joining it with other nerves near the skull, to be now considered. Branches join it with

Connecting branches. — Near the skull the hypoglossal is connected by branches with the vagus nerve, the two being almost inseparably united. the vagus,

Rather lower down the nerve has connecting offsets with the sympathetic, and with the loop of the first two spinal nerves. sympathetic, and spinal;

The *branches for distribution* to parts around are included in the description of the dissections of the neck, submaxillary region, and tongue. and supplies muscles.

Dissection. — The small rectus capitis lateralis muscle, between the transverse process of the atlas and the base of the skull, is now to be more completely cleaned. At its inner border the anterior branch of the first cervical nerve, which joins in the loop of the atlas, is to be found. Dissection of rectus lateralis.

The RECTUS CAPITIS LATERALIS is a small thin muscle, which is the representative of an intertransverse muscle. It *arises* from the anterior root (parapophysis), and the tip Rectus lateralis is first inter-trans-

verse muscle. of the transverse process of the atlas; and is inserted into the jugular eminence of the occipital bone. On the anterior surface rests the jugular vein; and in contact with the posterior is the vertebral artery. To the inner side is the anterior primary branch of the first cervical nerve.

Dissection of first nerve. *Dissection.*— For the purpose of tracing backwards the anterior branch of the first cervical nerve to its ganglion, divide the rectus lateralis muscle, observing the branch of nerve to it; then cut off the end of the transverse process of the atlas, and remove the vertebral artery, so as to bring into view the nerve as it lies on the first vertebra.

Sub-occipital nerve lies on atlas, The *anterior* primary branch of the *first*, or suboccipital *nerve*, is slender in size, and arises from the common trunk on the neural arch of the atlas. From that origin it is directed forwards on the arch, beneath the vertebral artery, to the inner side of the rectus lateralis. Here the nerve bends down in front of the transverse process, and forms a loop by uniting with the second cervical nerve. Branches pass between this loop and the vagus, hypoglossal, and sympathetic nerves. As the nerve passes forwards it supplies the rectus lateralis muscle, and sends a filament along the side of the vertebral artery.

forms a loop with second.

Branches.

Sympathetic nerve in neck has three ganglia: SYMPATHETIC NERVE.— In the neck the sympathetic nerve consists, on each side, of a gangliated cord, which lies close to the vertebral column, and is continuous with the similar cord in the thorax. On this part of the nerve are three ganglia: — one near the skull, another on the neck of the first rib, and a third midway between the two; these are named respectively superior, inferior, and middle ganglion. From the ganglia proceed some branches that are connected with the spinal and most of the cranial nerves, and other branches that are distributed to viscera.

other ganglia on fifth nerve. Besides the ganglia above mentioned, there are other ganglionic masses in the head and neck, in connection with the three trunks of the fifth nerve.

Dissection of upper ganglion. *Dissection.*— To dissect the branches of the sympathetic nerve requires greater care than is necessary in following the white-fibred nerves, for they are softer, more easily torn, and generally of smaller size. In the neck the ganglia and their

branches are already partly prepared, and will therefore require only the following additional dissection to bring them into view: — the carotid artery and jugular vein having been already cut through, the upper ganglion will be seen by raising the trunks of the eighth and ninth nerves, and cutting through the branches that unite these to the loop of the atlas. If it is thought necessary, the two cranial nerves may be cut across close to the skull. The several branches of the ganglion should be traced upwards, inwards, and outwards.

The dissector has already seen the middle ganglion on or near the inferior thyroid artery, and has now to trace out its branches. Middle

To obtain a view of the inferior ganglion, the greater part of the first rib is to be taken away, and a part of the subclavian artery is to be removed, without however destroying the fine nerves that pass over it. Of course the clavicle is supposed not to be in position. The ganglion is placed on the neck of the first rib; its branches are large, and are easily followed to the vertebral artery, the spinal nerves, and the thorax. and inferior ganglion.

The SUPERIOR CERVICAL GANGLION is the largest of the cervical ganglia, and is of a reddish grey colour. Of a fusiform shape, it is as long as two cervical vertebræ (second and third), and is placed on the rectus capitis anticus major muscle, beneath the carotid artery and the cranial nerves in connection with it. Branches connect the ganglion with other nerves, and some are distributed to the bloodvessels, the pharynx, and the heart. Superior ganglion is near skull, beneath carotid.

Connecting branches unite the sympathetic with both the spinal and the cranial nerves. Branches join it

With the spinal nerves. — The four highest spinal nerves have branches of communication with the upper ganglion of the sympathetic; but the branch to the fourth spinal nerve may come from the cord connecting the upper to the next ganglion. with spinal nerves,

With the cranial nerves.— Near the skull the trunks of the vagus (its lower ganglion) and hypoglossal nerves are joined by branches of the sympathetic. In the foramen jugulare also, both the petrosal ganglion of the glosso-pharyngeal and the ganglion of the root of the vagus receive small filaments, one to each, from an ascending offset of the ganglion. with cranial outside skull,

Communications are formed with other cranial nerves by means and with some in

the skull. of the offset continued upwards from the ganglion into the carotid canal.

Branches are sent *Branches for Distribution.* — This set of branches is more numerous than the preceding, and the nerves are of larger size.

to external carotid, 1. *Branches for bloodvessels* (nervi molles). These nerves proceed to the external carotid artery, and ramify on its branches, forming plexuses on the vessels, which have the same name as the arteries they surround. Some small ganglia are occasionally found forming plexuses and ganglia; on these ramifying branches. By means of the plexus on the facial artery the submaxillary ganglion communicates with the sympathetic; and through the plexus on the internal maxillary artery the otic ganglion is supplied with a similar communication.

to internal carotid, With these nerves may be described another offset of the ganglion to the internal carotid artery and its branches. This offset ascends from the upper part of the ganglion, of which it appears to be a continuation. Near the skull it divides into two pieces, that enter the canal for the carotid artery, one on each side of that which join cranial nerves; vessel, and are continued, forming secondary plexuses on the ophthalmic and cerebral arteries, to the eyeball and the meninges of the brain. In the carotid canal communications are formed with the tympanic nerve (p. 115.) and with the spheno-palatine ganglion (p. 148.); the former being placed near the lower, and the latter near the upper opening of the canal. The communications and plexuses that these nerves form in their course to the base of the brain are described at p. 22.

to pharyngeal plexus; 2. The *pharyngeal nerves* pass inwards to the side of the pharynx, where they join in the pharyngeal plexus with the other pharyngeal branches of the eighth cranial nerve.

to cardiac plexuses. 3. *Cardiac nerves.*— The cardiac nerves enter the thorax to join in the cardiac plexuses of the heart. There are three cardiac nerves on each side, viz. superior, middle, and inferior, each taking its name from the ganglion of which it is an offset.

One nerve to deep plexus The *superior* or superficial *cardiac nerve* of the right side continues through the neck, behind the sheath of the carotid vessels, and enters the thorax beneath, or in front of the subclavian artery. In some bodies this nerve ends in the neck by joining one of the joins others in neck. other cardiac nerves. In the neck the nerve is connected with the cardiac branch of the vagus, with the external laryngeal, and with the recurrent nerve.

Middle ganglion. The MIDDLE CERVICAL GANGLION (gang. thyroideum) is of small size, and is situate opposite the fifth cervical vertebra,

usually on or near the inferior thyroid artery. It is of a roundish shape, and lies beneath the great cervical vessels. Its branches are the following:— Situation.

Connecting branches with the spinal nerves pass outwards, and sink between the borders of the longus colli and anterior scalenus to join the fifth and sixth cervical nerves. Is joined to spinal nerves,

Branches for Distribution.—These consist of nerves to the thyroid body, together with the middle cardiac nerve. and gives offsets, viz.

1. The *thyroid branches* ramify around the inferior thyroid artery, and end in the thyroid body; they join the external laryngeal and recurrent laryngeal nerves. thyroid branches

2. The *middle* or great *cardiac nerve* descends to the thorax across the subclavian artery; its termination in the cardiac plexus will be seen in the chest. In the neck it communicates with the upper cardiac and recurrent laryngeal nerves. and a cardiac nerve.

The INFERIOR CERVICAL GANGLION is irregular in shape, and occupies the interval between the first rib and the transverse process of the last cervical vertebra, its position being internal to the superior intercostal artery. Oftentimes it extends in front of the neck of the rib, and joins the first swelling of the knotted cord in the thorax. One or two filaments around the trunk of the subclavian artery likewise connect these ganglia, and supply filaments to that blood-vessel. Its branches are very similar to those of the other ganglia. Inferior ganglion is on neck of first rib. Branches to blood-vessels,

Connecting branches join the last two cervical nerves. Other nerves accompany the vertebral artery in its canal, forming a plexus — *vertebral*, around it, and communicate with the spinal nerves as high as the fourth. and spinal nerves,

Only one branch for distribution, the *inferior cardiac nerve*, issues from the lower ganglion. It lies beneath the subclavian artery, joining in that position the recurrent laryngeal nerve, and then enters the thorax to terminate in the deep cardiac plexus behind the arch of the aorta. and one nerve to cardiac plexus.

Directions. — The right half of the head and neck should now be carefully preserved during the time occupied in the examination of the left half.

Section X.

DISSECTION OF THE LEFT SIDE OF THE NECK.

Left side differs from right. In repeating the dissection of the left half of the neck, the differences observable between it and the right side are specially to be studied. When the description of the right side will suffice, reference will be made to it.

Dissection of anterior triangle of neck, *Directions.*—After the neck has been made tense over a narrow block, the anterior triangle and the anterior part of the neck are to be prepared as on the opposite side. The description of the right side (p. 63.) is to be used for both those regions, for the sterno-mastoideus, and for the depressor muscles of the hyoid bone.

of scaleni and subclavian artery. Next the scaleni muscles and the subclavian vessels are to be taken. The dissection and description of those parts on the right side (p. 69.), will serve for these on the left, except that the student will meet on the left side with the thoracic duct. This little tube will be seen in connection with the part of the artery internal to the scalenus muscle, and crossing in front of the scalenus to join the subclavian vein. On this side, too, the clavicle may remain articulated.

Subclavian artery The LEFT SUBCLAVIAN ARTERY arises from the arch of the aorta, instead of from the innominate trunk, and ascends thence, over the first rib, in its course to the upper limb. differs much from right subclavian With this difference on the two sides in the origin of the subclavian,—the one vessel beginning opposite the sterno-clavicular articulation, the other in the thorax,—it is evident that the length and connections of the part of the artery on the inner side of the scalenus must vary much on opposite sides.

in the first part of its extent. *First part.*—The part of the artery internal to the anterior scalenus is much longer on the left than the right side, and is almost vertical in direction, instead of being horizontal like its fellow. Moreover, after it leaves the chest it is deeply placed in the neck, near the spine and the œsophagus, and does not rise so high above the first rib as the right subclavian. Connections with surrounding parts. Between the artery and the surface are the same parts as are superficial to the right vessel, viz. the common teguments and deep fascia, with the sterno-mastoid,

hyoid, and thyroid muscles. Behind the vessel is the longus colli muscle, with the inferior ganglion of the sympathetic. To the inner side are the œsophagus and the thoracic duct; and the pleura is in contact with the anterior and outer parts. Its connections lower in the chest are described in the dissection of the thorax.

Position of vagus and internal jugular vein to it.

The pneumo-gastric nerve is in connection with this part of the artery, but its position is parallel to the vessel instead of across it, as on the right side. The internal jugular vein, in like manner, is parallel to the artery for a short distance, and superficial to it. Accompanying also the subclavian artery are the cardiac branches of the sympathetic, which course along the side of the vessel to the chest.

Rest of the artery.

The *second* and *third* parts of the artery, viz. beneath and beyond the scalenus, are nearly the same as on the right side; but the student must note for himself the variations that may exist in the connections.

Branches resemble those of right vessel.

The *branches* of this artery resemble so closely those of the right trunk, that one description will serve for both. It may be remarked, that the superior intercostal of the left side is usually internal to, instead of beneath the scalenus; in other words, this branch arises sooner (see p. 75.).

Thoracic duct comes from thorax and joins subclavian vein.

The *thoracic duct* conveys the chyle and lymph of the greater part of the body into the venous circulation. Escaping from the thorax between the subclavian artery and the œsophagus, the duct ascends in the neck as high as the seventh or sixth cervical vertebra. At the spot mentioned as its highest extent, the duct arches outwards above the subclavian artery, and in front of the scalenus muscle and the phrenic nerve, to open into the subclavian vein rather external to the union of this with the jugular vein. Double valves, like those of the veins, are present in the interior of the tube; and two guard the opening into the posterior part of the vein, to prevent the passage of the blood into it. Commonly the upper part of the duct is divided; and there may be separate openings in the large vein, corresponding to those divisions.

Spinal nerves.

Examine next the brachial and cervical plexuses, using the description of the right side (p. 76).

Difference in origin of

Common carotids.—On opposite sides these vessels have differences like those between the right and left subclavian

right and left carotids. arteries; for on the left side the vessel arises alone, and from the arch of the aorta, and is therefore deep in the chest, and longer than the right. The part of the artery between its origin and the upper piece of the sternum will be seen in the dissection of the thorax.

In the neck Beyond the sterno-clavicular articulation the vessels, on both sides, so nearly resemble one another that the same description will serve for the two (p. 79.). It must be remarked however that, on the left side, the jugular vein and the pneumo-gastric nerve are much nearer to the accompanying artery than on the right side, and are placed over the artery in the lower third of the neck.*

difference in vein and nerve.

Thyroid body consists of two lobes united by a cross piece. The THYROID BODY is a soft reddish mass, which is situate opposite the upper part of the trachea. It consists of two lobes, one on each side, which are united by a narrow piece across the front of the windpipe. The connecting piece, about half an inch in depth, is named the *isthmus*, and is placed opposite the second and third rings of the air tube.

Connections and extent of lobes. Each lobe is somewhat conical in shape, with the smaller end upwards, and is about two inches in length. It is interposed between the windpipe and the sheath of the common carotid artery, and is covered by the sterno-thyroid, sterno-hyoid, and omo-hyoid muscles. The extent of the lobe depends upon the variations in its size; but usually the lateral piece reaches as high as the ala of the thyroid cartilage, and as low as the sixth ring of the trachea.

Accessory piece or pyramid. From the upper part of the thyroid body, and most commonly from the left lobe, there is occasionally found a conical piece — *pyramid* — ascending towards the hyoid bone, to which it is connected by a fibrous band. Sometimes this part is attached to the hyoid bone by a slip of muscle, the *levator glandulæ thyreoideæ* of Sœmmerring.

Weight and size. This body is of a brownish red or purple hue, and weighs from one to two ounces. Its size is larger in the woman than in the man. No excretory tube has been found attached to it.

No distinct capsule. *Structure.* — The thyroid body is not provided with a distinct capsule; but it is surrounded by connective tissue, that

* Sometimes these differences will be reversed — the vein and nerve being over the artery on the right side, and away from it on the left.

projects into the substance and divides this into masses. It has a granular texture.

The substance of the gland consists of spherical or elongated vesicles, which vary in size, some being as large as the head of a small pin, and others only $\frac{1}{850}$th of an inch. These vesicles are simple sacs, distinct from one another, and contain a yellow fluid, with nuclear-like bodies; in the wall of the vesicles is found a thin proper membrane with a nucleated epithelial lining. Capillary vessels and connective tissue unite the vesicles together into small irregular masses or lobules, of the size of the little finger nail. On cutting into the gland a viscid yellowish fluid escapes. Consists of vesicles, yellow fluid, and nuclear bodies.

Bloodvessels.— The *arteries* to the thyroid body are two on each side — superior and inferior thyroid; and occasionally there is an additional branch — lowest thyroid, from the innominate artery. The branches of the external carotid (superior thyroid) ramify chiefly on the anterior aspect; while those from the subclavian (inferior thyroid) pierce the under surface of the thyroid body. A very free communication is established between all the arteries; and in the substance of the thyroid body the arteries form a fine network around the vesicles, and so pass into the capillary radicles of the veins. Blood-vessels. Superior, inferior, and lowest thyroid arteries.

The *veins* are also large and numerous; they are superior, middle, and inferior thyroid on each side. The first two have been traced to the internal jugular vein (p. 111.). The *inferior thyroid veins*, two in number, issue from the lower part of the thyroid body, and descend on the trachea, the two forming a plexus on that tube beneath the sterno-thyroid muscles; each finally enters the innominate vein of its own side. Veins. Inferior form a plexus on the trachea.

The TRACHEA, or air tube, is continued from the larynx to the thorax, and ends by dividing into two tubes (bronchi), one for each lung. It occupies the middle line of the body, and extends commonly from the fifth cervical to the third dorsal vertebra, measuring about four inches and a half in length, and nearly one in breadth. The front of the trachea is rounded in consequence of the existence of firm cartilaginous bands in the anterior wall, but at the posterior aspect the cartilages are absent, and the tube is flat and muscular. Its cavity remains pervious in health, under all conditions. Trachea lies in neck and thorax. Form.

The cervical part of the trachea is very moveable, and has the following relative position to the surrounding parts. Cervical part is amongst

muscles Covering it in front are the small muscles reaching from the sternum to the hyoid bone, with the deep cervical fascia: beneath the muscles is the inferior thyroid plexus of veins; and near the larynx is the isthmus of the thyroid body. Behind the tube is the œsophagus, with the recurrent nerves. and vessels. On each side are the common carotid artery and the thyroid body.

The structure of the trachea is described at p. 176.

Œsophagus occupies neck and thorax. The ŒSOPHAGUS, or gullet, reaches from the pharynx to the stomach. It commences, like the trachea, opposite the fifth cervical vertebra, and ends opposite the tenth dorsal vertebra. In length it measures about nine inches. This tube reaches through part of the neck, and through the whole of the thorax, and occupies for the most part the middle line of the body.

Position in neck and connections. In the neck its position is behind the trachea, till near the thorax, where it projects to the left side beyond the air tube, and comes into connection with the thyroid body and the thoracic duct. Behind the œsophagus is the longus colli muscle. On each side is the common carotid artery, the proximity of the left being greatest, because of the projection of the œsophagus towards the same side.

The structure of the œsophagus will be examined in the dissection of the thorax.

Muscles and nerves in anterior triangle. *Directions.*— The dissector may learn next the digastric and stylo-hyoid muscles, with the hypoglossal nerve; and afterwards, the trunk of the external carotid, with the following branches,— superior thyroid, facial, occipital, posterior auricular, and superficial temporal. The description of the right side (p. 79.) may be used for these parts.

Pterygo- and submaxillary regions to be omitted. The dissector is not to examine the pterygo-maxillary or submaxillary regions on this (the left) side of the neck, because such a proceeding would interfere with subsequent dissections. Before learning the pharynx he should lay bare, on this side, the middle and inferior ganglia of the sympathetic with their branches.

Dissection of sympathetic, *Dissection.*— For the dissection of the two lower ganglia of the sympathetic and their branches, it will be necessary to cut across the common carotid artery at the lower part of the neck, and the external and internal carotid where these are crossed by the digastric muscle. In removing the ves-

sels with the internal jugular vein, care must be taken of the sympathetic beneath them. The upper end of the sternum with its attached clavicle is next to be taken away, by cutting through the middle of the first rib; and the piece of bone thus obtained is to be put aside for the subsequent examination of the sterno-clavicular articulation. The middle ganglion must be sought in the connective tissue near the inferior thyroid artery; and the inferior one will be seen on the neck of the first rib, after a piece of the subclavian artery has been cut out. The upper cardiac nerve will be found descending beneath the carotid sheath. viz. middle and lower ganglia.

The *middle* and *inferior cervical ganglia* of the sympathetic nerve are so similar to the corresponding ganglia of the right side, that the same description will suffice (p. 122.). Ganglia of sympathetic nerve.

The *cardiac nerves* are three in number on the left, as on the right side, viz. superior, middle, and inferior, but they present some peculiarities. Cardiac nerves.

The *superior cardiac nerve* has on both sides a similar course in the neck; but the left in entering the chest is between the carotid and subclavian arteries, and parallel to them. Upper.

The *middle cardiac nerve* frequently unites with the next nerve, and passes beneath the subclavian artery to the deep cardiac plexus. Middle.

The *inferior cardiac nerve* is generally a small branch that enters the thorax conjoined with the preceding, and ends in the cardiac plexus. Lower.

Section XI.

DISSECTION OF THE PHARYNX.

The pharynx, or the commencement of the alimentary passage, can be examined only when it has been separated from the rest of the body; and it will therefore be necessary to cut through the base of the skull in the manner mentioned below, so as to have the anterior half, with the pharynx connected to it, detached from the posterior half.

Dissection.—Preparatory to sawing the skull certain other steps are needed. In the first place, the block being removed from beneath the neck, the head is to be placed downwards, so that it may stand on the cut surface of the skull. Next the trachea and œsophagus, together with the vagus To detach pharynx

and sympathetic nerves, are to be cut near the first rib (should these be still uncut), and all are to be separated from the spine as high as the basilar process of the occipital bone, but without disturbing, on the left side, the vessels and nerves near the skull.

partly divide base of skull externally,

For the division of the skull, let the dissector chisel through the basilar process of the occipital bone, between the attachments of the pharynx and the muscles of the spinal column, the cut being directed backwards. Turning upwards then the inner surface of the base of the skull, the dissector will make the following incisions in the posterior fossa. On the right side, a cut with a chisel is to be carried along the line of union of the petrous part of the temporal with the occipital bone, as far inwards as the incision across the basilar process. On the left side, another cut with the chisel is to be made in the same direction, but through the occipital bone, internal to the foramen jugulare and the inferior petrosal sinus: this is to begin rather behind the foramen, and to end opposite the one on the other side. Lastly, the side of the skull is to be sawn through close behind the mastoid part of the temporal bone, so that the incision shall meet the outer end of the cut made with the chisel. The base of the skull is now divided into two parts; one having the pharynx attached to it, the other articulating with the spine,—which can be readily separated with a scalpel.

and cut the remainder from inside,

and then cut soft parts.

Preserve piece of spine.

The spinal column, with the piece of the occipital bone connected with it, should be set aside, and kept for after examination.

Fasten pharynx in position.

Dissection of the pharynx.—Let the student take the anterior part of the divided skull, and, after moderately filling the pharynx with tow, fasten it with hooks on a block, so that the œsophagus may be pendent and towards him.

Dissect nerves on left side,

On the left side of the pharynx a view may be obtained of the eighth, ninth, and sympathetic nerves near the skull, when some loose connective tissue, and the styloid process with its muscles have been removed.

and muscles on the opposite.

Afterwards, on one side, say the right, the dissector may proceed to remove the fascia from the constrictor muscles in the direction of their fibres, these radiating from the side to the middle line. The margins of the two lower constrictor muscles (middle and inferior) are to be defined. Beneath

the lower one, near the larynx, will be found the recurrent nerve; whilst, intervening between the middle and superior, are the stylo-pharyngeus muscle and the glosso-pharyngeal nerve. To see the attachment of the superior constrictor to the lower jaw and the pterygo-maxillary ligament, it will be necessary to cut through the internal pterygoid muscle. Above the upper fibres of this constrictor, and near the base of the skull (petrous part of the temporal bone), will be found two small muscles of the palate: — one, — tensor palati, lies between the internal pterygoid plate and the pterygoid muscle; and the other, — levator palati, is rather farther back, and of larger size.

Pharynx is behind mouth and nose.

The PHARYNX is that part of the alimentary tube which is situate behind the nose, mouth, and larynx. Through the upper part of this passage, besides the food, the air is transmitted in respiration. Its extent is from the base of the skull to the cricoid cartilage of the larynx, where it ends in the œsophagus. In form it is somewhat conical, with the base or dilated part upwards, and the apex or narrower part downwards. In length it measures about four inches and a half.

Extent, form, and length.

Is an incomplete bag; is between blood-vessels and in front of spine.

The tube of the pharynx is incomplete in front, where it communicates with the cavities above mentioned, but is quite closed behind. On each side of the pharynx are the trunks of the carotid arteries, with the internal jugular vein and the accompanying eighth, ninth, and sympathetic nerves. Behind it is the spinal column, covered by the deep muscles, viz. longus colli and rectus capitis anticus major.

Components.

In front the pharynx is attached to the larynx, the hyoid bone, and the tongue, and to the bony framework of the nasal cavity; but behind it is unattached, and is formed of thin, fleshy and membranous strata. In the posterior wall are three thin muscles, which are so arranged that the lower overlays the middle, and the middle the upper muscle, like the disposition of scales; and at the upper part the bag is farther completed by an aponeurotic expansion which fixes it to the base of the skull. The whole is lined by mucous membrane.

Aponeurosis of pharynx:

The *aponeurosis* of attachment is seen at the upper part of the pharynx, where the muscular fibres are deficient, to connect the muscular part to the base of the skull, and to com-

plete the posterior boundary. Superiorly, it is fixed to the basilar process of the occipital bone, and the petrous part of the temporal bone, as well as to the cartilage between them; but inferiorly it becomes thin, and extends between the muscular and mucous strata. On this membrane some of the fibres of the constrictor muscles terminate.

Lower constrictor muscle arises from larynx and ends in the middle line.

The INFERIOR CONSTRICTOR, the most superficial of the muscles of the pharynx, *arises* from the side of the cricoid cartilage, from the oblique line and the upper and lower borders of the ala of the thyroid cartilage, and from the part of the last cartilage behind that line. The origin is small when compared with the insertion, for the fibres are directed backwards, radiating, and are *inserted* along the middle line, where it meets the corresponding muscle of the opposite side. The outer surface of the muscle is in contact with the sheath of the carotid artery, and with the muscles covering the spinal column. The lower border is straight, and is continuous with the fibres of the œsophagus; whilst the upper border overlaps the fibres of the middle constrictor. The recurrent nerve enters beneath the lower border.

Parts in contact with it.

Middle constrictor passes from hyoid bone to the middle line behind.

The MIDDLE CONSTRICTOR MUSCLE has nearly the same shape as the preceding, that is to say, it is narrow in front and expanded behind. Its fibres *arise* from the great cornu of the os hyoides, from the small cornu of the same bone, and from the stylo-hyoid ligament. From this origin the fibres radiate, and are blended along the middle line with the other muscles. The surfaces of the muscle have connections similar to those of the preceding constrictor. The upper border is separated from the superior constrictor by the stylo-pharyngeus muscle and the glosso-pharyngeal nerve, and ends on the aponeurosis of the pharynx, about an inch from the base of the skull. The lower border descends beneath the inferior constrictor; and opposite the interval between the two is the superior laryngeal nerve.

Connections.

Stylo-pharyngeus.

The *stylo-pharyngeus muscle* may be again seen with the pharynx. Its description is given at p. 108.

Upper constrictor. Origin in front.

The SUPERIOR CONSTRICTOR is the least strong of the three muscles, and wants the same regular or conical form. Its *origin* is extensive, and is connected successively, from above down, with the inner surface of the internal pterygoid

plate (the lower third), with the pterygo-maxillary ligament, with the posterior part of the mylo-hyoid ridge of the lower jaw, and with the mucous membrane of the mouth and the side of the tongue. The fleshy fibres pass backwards, and are *inserted* on the aponeurosis of the pharynx, as well as into the *raphé* along the middle line. The parts in contact, externally, with this muscle are all the deep vessels and nerves of the neck; and internally, it is lined by the aponeurosis and the mucous membrane. The upper border consists of the arched fibres which are directed backwards from the pterygoid plate, and above it the levator and tensor palati muscles are seen. The lower border is overlaid by the middle constrictor muscle. The attachment to the pterygo-maxillary ligament corresponds to the origin of the buccinator muscle.

Insertion behind as the others. Contiguous parts.

Dissection. — Open the pharynx by an incision along its middle, and, after removing the tow from the interior, keep it open with hooks. A better view of the cavity will be obtained by partly dividing the occipital attachment on each side. The mucous membrane is to be carefully removed from the end of the opening of the Eustachian tube by the side of the nostril, for the purpose of finding some pale muscular fibres, with the name salpingo-pharyngeus, that descend from it.

Dissection.

Salpingo-pharyngeus muscle. — This little band is fixed by tendon to the lower border of the cartilage of the Eustachian tube near the orifice. The fleshy fibres that succeed end below by joining those of the palato-pharyngeus. It is oftentimes absent.

Salpingo-pharyngeus. Attachments.

The *interior of the pharynx* is wider from side to side than from before back, and its greatest width is opposite the hyoid bone; from this spot it diminishes both upwards and downwards, but much more rapidly in the latter than in the former direction. In it the following objects are to be noticed: — At the top are the posterior apertures of the nasal cavity, which are separated by the septum nasi; and below them is the soft palate, partly closing the cavity of the mouth. By the side of each aperture is the trumpet-shaped end of the Eustachian tube. Below the soft palate is the opening into the mouth — isthmus faucium; and on each side of this is the tonsil, which is placed in a hollow between

Interior of pharynx.

Objects to be noted.

two prominences named pillars of the soft palate, — the one proceeding from the soft palate to the side of the tongue, and the other from the same part to the side of the pharynx. Next in order, below the mouth, is the aperture of the larynx: and close in front of it is the epiglottis, or the valve which assists to close that opening during deglutition. And lowest of all is the opening from the pharynx into the œsophagus.

Seven apertures, viz. The *apertures* into the pharynx then are seven in number, and have the following position and boundaries : —

Posterior nares. The posterior *openings* of the *nasal fossæ* are two in number. Each is oval in form, is constructed of the osseous parts that bound it in the dried skull, and is lined by mucous membrane.

Eustachian tube; The *Eustachian tube* is a canal, partly osseous, partly cartilaginous, by which the tympanic cavity of the ear communicates with the external air. Only the cartilaginous part that is external to the bone can now be seen.

cartilaginous part is an inch long, If the mucous membrane be removed from the tube on one side, the cartilaginous part appears to be nearly an inch long. It is narrow superiorly, where it is fixed to the margins of a groove between the sphenoid and the petrous part of the temporal bone; directed downwards to the pharynx, it ends by a wide aperture opposite the inner surface of the internal pterygoid plate, and rather above the inferior spongy bone of the nose. Its opening in the pharynx is oval in form; and the inner side, which is larger than the outer, projects forward, giving rise to a trumpet-shaped mouth. This part of the tube is constructed chiefly by a triangular piece of cartilage, whose margins are bent downwards so as to enclose a narrow space; but at the outer and under aspect the cartilage is deficient, and the wall is formed by fibrous membrane. Closely united to the pterygoid plate, the tube is covered by the mucous membrane; and through it the mucous lining of the cavity of the tympanum is continuous with that of the pharynx.

has a wide opening; is a bent piece of cartilage. Mucous membrane covers and lines it.

Opening of the fauces. The *isthmus faucium* is a somewhat narrowed passage between the mouth and the fauces, whose size is altered by the elevated or pendent position of the soft palate. The space is bounded below by the root of the tongue; above by the soft palate; and on each side by those projecting arches of the soft palate, which are named *pillars* of the *fauces*.

The *aperture of the larynx* is wide in front, where it is bounded by the epiglottis, and pointed behind between the arytænoid cartilages. The sides are sloped from before back, and are formed by folds of the mucous membrane extending between the arytænoid cartilages and the epiglottis. During respiration this aperture is unobstructed, but during the act of deglutition it is closed by the epiglottis. Upper opening of larynx.

The *opening into the œsophagus* is the narrowest part of the pharynx, and is opposite the cricoid cartilage, or the fifth cervical vertebra. Internally, the mucous membrane in the œsophagus is paler than in the pharynx; and externally, the point at which the pharynx ends is marked by a slight contraction, and by a change in the direction of the muscular fibres. Beginning of œsophagus.

The SOFT PALATE (velum pendulum palati) is a moveable structure between the mouth and the pharynx, which can either close the isthmus of the fauces, or cut off the passage to the nose, according as it is depressed or elevated. In the usual position of the soft palate (the state of relaxation) the anterior surface is somewhat curved, and is continuous with the roof of the mouth, whilst the opposite surface is convex and turned to the pharynx. The upper border is fixed to the posterior margin of the hard palate; and each lateral part joins the pharynx. The lower border is free, and presents in the centre a conical pendulous part — the *uvula*. Along the middle line is a slight prominence, indicative of the original separation into two halves. Soft palate is at back of mouth; surfaces, borders; from it hangs uvula.

Springing from the lower part of the soft palate, near to the uvula, are two folds on each side, containing muscular fibres, which are directed downwards on the sides of the isthmus faucium. These are named *arches* or *pillars* of the *palate*, and are distinguished from one another by their relative position. The *anterior* one reaches the side of the tongue near its root; and the *posterior*, longer than the other, is continued to the side of the pharynx. As they diverge from their origin to their insertion, they limit a triangular space, in which the tonsil lies. Arches or pillars; anterior, posterior.

The velum consists of an aponeurosis, together with muscles, vessels and nerves, and mucous glands; and the whole is enveloped by the mucous membrane. Elements of velum.

Dissection of the muscles.

Dissection.— Some of the muscles of the palate are readily displayed, but others require great care in their dissection.

Levator and tensor on right half.

On the right side, the two principal muscles of the soft palate — the elevator and tensor, are to be seen. These have been partly dissected on the outside of the pharynx, but to follow them to their termination, let the upper attachment of the pharynx on the same side, and the part of the superior constrictor which arises from the internal pterygoid plate, be cut through. The levator will be fully laid bare by the removal of the mucous membrane and the muscular fibres covering its lower part; and the tendon of the tensor palati should be followed round the hamular process of the pterygoid plate. The position of the Eustachian tube with respect to those muscles should be defined.

On left, palato-pharyngeus, azygos uvulæ, and palato-glosss.

On the left side, the mucous membrane is to be raised with care from the posterior surface of the palate, to obtain a view of the superficial submucous fibres: for immediately beneath the mucous covering are some transverse fibres of the palato-pharyngeus muscle; and beneath these, in the middle line, are the longitudinal fibres of the azygos uvulæ. The student should next remove the mucous membrane from the muscular fibres constituting the arches of the palate, and should follow them upwards and downwards: in order to see those of the anterior fold, it will be necessary to take the membrane from the anterior surface of the palate. If the part is not tolerably fresh, some of the paler fibres will not be visible.

Aponeurosis of palate.

Aponeurosis of the soft palate.— Giving strength to the velum is a thin but firm aponeurosis, which is attached to the hard palate. This membrane becomes thinner as it descends in the velum; and it is joined by the tendon of the tensor palati muscle.

Nine muscles.

The MUSCLES of the soft palate are four on each side, — an elevator and tensor; together with the palato-glossus and palato-pharyngeus, which act as depressors. In addition there is a small central azygos muscle.

Elevator muscle arises outside pharynx,

The LEVATOR PALATI is a thick, roundish muscle, and is partly situate outside the pharynx. It *arises* from the under surface of the apex of the petrous portion of the temporal bone, and from the inner and under part of the cartilage of the Eustachian tube. The fibres descending, enter the

pharynx above the superior constrictor, and then spread out in the soft palate, where they join along the middle line with those of the muscle of the opposite side. Outside the pharynx this muscle rests against the Eustachian tube. In the palate it forms a stratum that reaches the whole depth of that structure, and is embraced by the two planes of fibres of the palato-pharyngeus. and is lost in velum.

The TENSOR vel CIRCUMFLEXUS PALATI arises like the preceding outside the palate and pharynx: it is a thin, riband-like band, which is tendinous at its deep border, and is situate between the internal pterygoid plate and the pterygoid muscle. The muscle is about one inch and a half wide at its origin, and is attached to the slight depression (scaphoid fossa) at the root of the internal pterygoid plate, to the outer part of the Eustachian tube, and still farther out to the spinous process of the sphenoid, and to the front of the vaginal (tympanic) process of the temporal bone. Inferiorly the fleshy fibres end in a tendon, which is reflected round the hamular process, and is *inserted* into about half an inch of the posterior border of the palate, viz. from the central spine to a projecting point; whilst inferiorly the tendon joins the aponeurosis of the velum. As the tendon winds round the bone, it is thrown into folds; and in the soft palate it lies beneath the levator muscle. The Eustachian tube is directed inwards between this muscle and the preceding one. Between the tendon and the hamular process is a small bursa. Tensor muscle arises outside pharynx, turns around hamular process, and ends in aponeurosis; is deeper than the other.

The PALATO-GLOSSUS MUSCLE (constrictor isthmi faucium) is a small, fleshy band of fibres, which is contained in the anterior arch of the soft palate, and reaches to the side of the tongue. The muscles of opposite sides narrow the opening between the mouth and fauces, hence the name that has been applied to them. It is connected inferiorly with the lateral surface and the dorsum of the tongue; from this spot the fibres ascend before the tonsil, to the anterior aspect of the soft palate, where they form a thin muscular stratum, and join those of the fellow muscle along the middle line. At its origin the muscle is blended with the glossal muscles, and at its insertion it is placed before the tensor palati. Palato-glossus. Attachments.

The PALATO-PHARYNGEUS is much larger in size than the preceding muscle; it gives rise to the eminence of the pos- Palato-pharyngeus,

in pillar of soft palate. terior pillar of the soft palate, and bounds the tonsil posteriorly. The muscle *arises* inferiorly from the posterior border of the thyroid cartilage, and some fibres blend with the contiguous portion of the pharynx. Ascending thence behind the tonsil, the fibres enter the side of the palate, and separate into two fleshy strata. The posterior of the two, thin and in contact with the mucous membrane, joins at the middle line the corresponding muscle. The deeper or anterior stratum, much the strongest, enters the substance of the palate between the levator and tensor, and joins also, at the middle line, the like part of the opposite muscle. In the palate the muscle encloses the levator palati and azygos uvulæ between its two strata.

Attachments.

Azygos muscle is single along middle; The AZYGOS UVULÆ is situate along the middle line of the velum near the posterior surface. The muscle consists of two narrow slips of pale fibres, which *arise* from the spine at the posterior border of the hard palate, or from the contiguous aponeurosis, and end inferiorly in the tip of the uvula. Behind this muscle, separating it from the mucous membrane, is the thin stratum of the palato-pharyngeus.

attachments.

Tonsil is between pillars of palate. The *tonsil* is a collection of muciparous follicles close above the base of the tongue, and between the arches of the soft palate. It is roundish in shape, but variable in size, and the apertures of the follicles are more or less apparent on its surface. Externally the tonsil is opposite the superior constrictor muscle, and the angle of the lower jaw; and when enlarged it may press against the carotid blood-vessels.

Vessels. Its *arteries* are numerous and are derived from the facial, lingual, ascending pharyngeal, and internal maxillary branches of the external carotid; and its *veins* have a plexiform arrangement on its outer side. *Nerves* are furnished to it from the fifth and eighth cranial nerves.

Nerves.

Mucous membrane of pharynx continued into the apertures. The *mucous membrane of the pharynx* is continuous anteriorly with the lining of the mouth and nose. Covering the soft palate and its numerous small glands (palatine), the membrane is continued to the tonsils on each side, and is prolonged by the Eustachian tubes to the tympanum. From the dorsum of the tongue it is continued over the epiglottis, forming three small folds, and then lines the pharynx. In front of each arytænoid cartilage it encloses a mass of muciparous glands (arytænoid). It is prolonged into

the larynx through the upper opening. Inferiorly, it is continued by the œsophagus to the stomach.

The mucous membrane is thicker, redder, and better provided with glands in the upper, than in the lower part of the pharynx; and its character, near the different apertures, resembles that of the membrane lining the cavities opening into the pharynx. Its epithelium is scaly below the palate, that is to say, in the part through which the food passes; but columnar and ciliated above that spot, where only the air is transmitted. Superiorly has columnar, inferiorly scaly epithelium.

Beginning of the œsophagus.—In addition to what has been said of the commencement of the œsophagus, and its connections in the neck, it may be remarked, that the size of this tube is less than that of the pharynx, and that the walls are flaccid. Beginning of œsophagus.

On dissection the tube will be found to consist of two layers of muscular fibres, with a lining of mucous membrane. Formed of two layers of fibres;

The *external layer* is formed of longitudinal fibres; these begin opposite the cricoid cartilage by three bundles, anterior and two lateral;—the former is attached to the ridge at the back of the cartilage, and the others join the inferior constrictor. The *internal layer*, on the other hand, is formed of circular fibres, which are continuous with those of the constrictor. The structure of the œsophagus is described more fully in the dissection of the thorax. outer or longitudinal, and inner or circular.

Section XII.

CAVITY OF THE MOUTH.

The cheeks, the lips, and the teeth, are to be examined with the mouth, as all may be considered accessory parts.

The Mouth.—The cavity of the mouth is situate below that of the nose, and extends from the lips in front to the isthmus of the fauces behind. Its boundaries are partly osseous and partly muscular, and its size depends upon the position of the lower jaw. When the lower jaw is moderately removed from the upper one, the mouth is an oval cavity with the following boundaries. The *roof* is concave, Mouth. Situation, form, and

boundaries. and is formed by the hard and soft palate, and is limited anteriorly by the arch of the teeth. In the *floor* is the tongue, bounded by the arch of the lower teeth; and beneath the tip of that body is the frænum linguæ, with the sublingual gland on each side. Each *lateral boundary* consists of the cheek and the ramus of the lower jaw; and in it, near the second molar tooth in the upper jaw, is the opening of the parotid duct. The anterior opening of the mouth is bounded by the lips, and the posterior corresponds to the pillars of the soft palate.

Lining of the mouth The *mucous membrane* of the mouth is much thicker on the hard than the soft parts bounding the cavity; it lines the interior of the cavity, and is reflected over the tongue. Anteriorly it is contiguous with the tegument, and posteriorly with the lining of the pharynx.

differs in parts, On tracing its disposition, the membrane is seen to form a small fold — frænulum, between each lip and the front of on roof, the corresponding jaw. On the bony part of the roof it is thick and thrown into folds, and covers vessels, nerves, and glands; but on the soft palate it is smooth and thinner. Along the middle of the palate is a ridge, which ends in floor, front in a small papilla. In the floor of the mouth, the membrane forms the frænum linguæ beneath the tip of the tongue, and sends tubes into the openings of the Whartonian and sublingual ducts; whilst on each side of the frænum it cheek, and lips. is raised into a ridge by the subjacent sublingual gland. On the interior of the cheek and lips the mucous lining is smooth, and is separated from the muscles by small buccal and labial glands in addition to the ordinary submucous tissue. Over the whole oral cavity, but especially on the lips, are found Epithelium. papillæ for the purpose of touch. The epithelium covering the membrane is of the scaly variety.

Cheek; extent The CHEEK extends from the commissure of the lips to the ramus of the lower jaw, and is attached, above and below, to the alveolar process of the jaws on the outer aspect. The and structure. chief constituent of the cheek is the fleshy part of the buccinator muscle: on the inner surface of this is the mucous membrane; and on the outer the integuments, with some muscles, vessels, and nerves. The parotid duct perforates the cheek near the second molar tooth of the upper jaw, and receives a lining of the mucous membrane.

The LIPS surround the opening of the mouth; they consist of the fleshy part of the orbicularis oris muscle, covered externally by integument, and internally by mucous membrane. The lower lip is the larger and more moveable of the two. Between the muscular structure and the mucous covering are the labial glands; and in the substance of the lip, nearer the inner than the outer surface, and at the line of junction of the two parts of the orbicularis, is the arch of the coronary artery. Lips, formed by orbicularis; contains coronary artery.

TEETH.—In the adult there are sixteen teeth in each jaw, which are set in the alveolar border of the maxilla, in the form of an arch, and are surrounded by the gums. Each dental arch has its convexity turned forwards; and, commonly, the arch in the upper overhangs that in the lower maxilla when the jaws are in contact. The teeth are similar in the half of each jaw, and have received the following names:—the most anterior two are incisors, and the one next behind is the canine tooth; two, still farther back, are the bicuspids, and the last three are molar teeth. Moreover, the last molar tooth has been also called "dens sapientiæ," from the late period of its appearance. The names applied to the teeth indicate very nearly the part they perform in mastication; thus the incisor and canine teeth act as dividers of the food, whilst the bicuspid and molar teeth serve to grind the aliment. Teeth, number and arrangement in jaw; different kinds. Use in mastication.

The several parts of the teeth, viz. the crown, fang, and neck; the general and special characters of these parts, and of the different groups of the teeth; and the structure of the different components of a tooth, must be referred to elsewhere.* Fuller notice elsewhere.

SECTION XIII.

DISSECTION OF THE NOSE.

To obtain a view of the interior of the nose, it will be necessary to make a longitudinal section through the base of the skull. Whilst the student is examining the boundaries of the nose, he should be provided with a vertical section of a skull. Directions.

* For this information the student may refer to the account of the teeth that has been given by Dr. Sharpey, in *Quain's Anatomy*.

Dissection before sawing bone. *Dissection.* — Before making the necessary sawing of the bone, the loose part of the lower jaw on the right side should be taken away; further, the tongue, hyoid bone, and larynx, all united, may be detached from the opposite half of the lower jaw, and laid aside till the dissector is ready to use them.

Cut through the bone with saw. The saw being placed on the right side of the crista galli of the ethmoid bone, is to be carried vertically through the frontal and nasal bones, the cribriform plate of the ethmoid, and part of the body of the sphenoid bone. Now the roof of the mouth is to be turned upwards, and the soft parts are to be divided on the right of the median line, opposite the cut in the roof of the nose; and the saw is then to be carried through the hard palate on the right side of the septum nasi, and through the body of the sphenoid bone, in such a direction as to make the cut join the incision from above. The piece of the skull is now easily separated into two parts, right and left; and by proceeding as above directed, the delicate bones of the nose are less injured than they would be by sawing continuously in one direction. The right half will serve for the examination of the meatuses, and the left will show the septum nasi.

Situation of nose. The CAVITY OF THE NOSE is placed in the centre of the bones of the face, being situate above the mouth, and between the orbits and the sinuses of the superior maxillary bones. Division into two. This space is divided into two parts — nasal fossæ, by a vertical partition.

Form. Each fossa is larger below than above; and is flattened in form, so that the measurement from before back or above down, exceeds much that from within out. Openings. It communicates with both the face and the pharynx by apertures named nares, and has also apertures of communication with the sinuses in the surrounding bones, viz. frontal, ethmoid, sphenoid, and superior maxillary. In each fossa are a roof and floor, an inner and an outer wall, and an anterior and a posterior opening, which are to be examined.

Roof. The *roof* is somewhat arched, and is formed by the cribriform plate of the ethmoid bone in the centre; by the frontal and nasal bones and the cartilages in front; and by the body of the sphenoid, the sphenoidal spongy bone, and part of the palate bone at the posterior part. Many apertures exist in

the ethmoid bone for the passage of the olfactory nerves, and in the front of the body of the sphenoid is the opening of its sinus.

The *floor* is slightly hollowed from side to side, and in it are found the palate and superior maxillary bones — their palate processes. Near the front is the incisor foramen leading to the anterior palatine fossa. Floor.

The *inner boundary* (septum nasi) is partly osseous and partly cartilaginous, and will be seen when the lining membrane has been removed. The osseous part is constructed by the vomer, by the perpendicular plate of the ethmoid bone, and by those parts of the frontal and nasal, with which this last bone articulates above. The irregular space in front in the prepared skull is filled by the *triangular cartilage of the septum*, which forms part of the partition between the nostrils, and supports the cartilages of the anterior aperture. Fixed between the vomer, the ethmoid plate, and the nasal bones, the cartilage rests anteriorly on the median ridge between the superior maxillæ, and projects even between the cartilages of each nostril. The septum nasi is commonly bent to one side. Inner boundary partly osseous, partly cartilaginous.

The *outer boundary* has the greatest extent and the most irregular surface. Six bones enter into the formation of this wall, and they come in the following order, when enumerated from before backwards: — the nasal and superior maxillary; the lateral mass of the ethmoid bone, with the small os unguis; and posteriorly the ascending part of the palate bone, with the internal pterygoid plate of the sphenoid bone: of these, the nasal, ungual, and ethmoidal reach only about half way from roof to floor, whilst the others extend the whole depth. Altogether in front of the bones, the lateral cartilages may be said to construct part of this boundary. On this wall are three convoluted osseous pieces, named *spongy* or *turbinate bones*, which project into the cavity: — the two upper are processes of the ethmoid, but the lower one is the inferior spongy bone. Between each turbinate bone and the wall of the nose, is a longitudinal hollow or meatus; and into these hollows, the nasal duct, and the sinuses of the surrounding bones open. Outer boundary, formed of many bones, is irregular on surface; presents hollows.

The *meatuses* are the spaces overhung by the spongy bones; and as the bones are limited to a certain part of Meatuses.

the outer wall, so is the extent of the spaces determined by them.

Upper fissure, or meatus,

The *upper* one is the smallest of the three meatuses, and occupies about the posterior half of the outer boundary: into it the posterior ethmoidal sinuses open at the front; and at its posterior part, in the dried bone, is the spheno-palatine foramen, by which the nerves and vessels enter the nose.

middle,

The *middle meatus* is longer than the preceding, and reaches about two-thirds of the length of the outer wall. It communicates anteriorly by a funnel-shaped passage (infundibulum) with the frontal sinus and the anterior ethmoidal cells; and near its middle is a small oblique aperture, about the size of a crow-quill, that leads into the cavity of the upper jaw.

lower.

The *inferior meatus* equals in length four-fifths of the outer wall of the nasal fossa; in its front is the opening of the ductus ad nasum, and nearly on a level with but behind it, the Eustachian tube may be seen.

Nares.

The *nares*. In the recent condition of the nose, each fossa has a distinct anterior opening in the face, and another in the pharynx; but in the skeleton there is only one common opening, in front, for both sides. These apertures, and the parts bounding them, have been before described (p. 33 and 134.)

Mucous lining of the nose.

The *mucous membrane* that lines the nasal fossa is called the pituitary or Schneiderian membrane. It is continuous with the integument at the nostrils, and with the membrane lining the pharynx through the posterior opening: moreover, it is also continuous, by means of the openings into the meatuses, with that of the tympanum and the eyeball, and that of the different sinuses, viz. frontal, ethmoidal, sphenoidal, and maxillary.

Differs on spongy bones and in sinuses.

In the lower region of the nose, where the air chiefly passes to the lungs, the membrane is thick, and closely united to the subjacent periosteum and perichondrium, and on the margins of the spongy bones it is projected somewhat by the large submucous vessels, so as to increase the extent of surface; but in the canals and sinuses it is very thin. Near the nostril it is furnished with papillæ, and small hairs

Some foramina closed,

(vibrissæ). The foramina in the dry bones, that transmit nerves or vessels, are entirely closed by the membrane, viz. incisor, spheno-palatine, and the holes in the cribriform

plate; but the apertures that lead to the sinuses and the orbit are only somewhat diminished by the lining they receive: the membrane is partly stretched over the opening of the ductus ad nasum, but in it is a small aperture. From the close connection of the mucous membrane with the periosteum, the lining membrane of the nose is sometimes called a fibro-mucous structure. others diminished by it.

The surface is covered by the apertures of muciparous glands, which are in greatest abundance, and of largest size, about the middle and posterior parts of the nasal fossa. In the lower part of the nose, and in the sinuses, its epithelium is of the columnar ciliated kind, which becomes laminated or scaly near the nostrils; but has special characters in the upper part of the cavity. Apertures of gland and epithelium.

*Olfactory region.**— This is the part of the nose in which the olfactory nerve is distributed, and is therefore the seat of the sense of smell. In this spot the mucous lining differs from that in the lower portion of the nose. Olfactory region.

This region is situate at the top of the nasal cavity, and is confined to the surface of the roof formed by the cribriform plate of the ethmoid bone; to a portion of the outer wall constructed by the upper, and part of the middle spongy bone; and to a corresponding extent of the septum, viz. about one third. Limits.

The epithelium of the mucous membrane covering this region is of a brownish tint, is laminar, and is composed of many strata. The glands of the part resemble further those of ordinary sweat glands in their position, and in the length and condition of the excretory tubes. Epithelium; glands.

Dissection.— By the time the student has arrived at this stage of the dissection, little will be seen of the distribution of the olfactory nerve. If the septum nasi be removed, so as to leave entire the membrane covering it on the opposite side (the left), the filaments of the nerve will appear on the surface, near the cribriform plate. On the membrane too, near the front of the septum, is a branch of the nasal nerve. At the same time the naso-palatine nerve and artery may be seen lower down, being directed from behind forwards, Dissection of nerves and vessels.

* This region has been specially described in the third part of the *Physiological Anatomy* of Dr. Todd and Mr. Bowman.

towards the anterior palatine fossa. By cutting through the fore part of the membrane that has been detached from the septum, other branches of the olfactory nerve may be traced along the outer wall of the nasal fossa.

Olfactory nerve

The OLFACTORY NERVE forms a bulb on the cribriform plate of the ethmoid bone, and sends branches to the olfactory region of the nose through the apertures in the roof. These branches are about twenty in number, and are divisible into three sets. An inner set descend in the grooves on the septum nasi, and then branching, extend over the upper third. A middle set is confined to the roof of the nose. And an external set is distributed on the two upper spongy bones, and on the flat surface of the ethmoid bone in front of them. As the branches of the olfactory nerve leave the skull, they receive tubes from the dura mater and pia mater, which are lost in the tissue to which the nerves are distributed. The nerves ramify in the pituitary membrane, and form tufts of filaments that communicate freely with the contiguous twigs, forming a network, but their mode of termination in the tissue is unknown.

is distributed to third of septum, the roof, and two spongy bones.

Structure.

The olfactory nerve differs in structure from the other cranial nerves; its branches are deficient in the white substance of Schwann, are not divisible into fibrillæ, and are nucleated and granular in texture. They resemble the gelatinous fibres, and seem to be formed of an extension of the nervous matter of the olfactory bulb. —(Todd and Bowman.)

The other branches of the nerves, together with the vessels which are found in the nose, will be described in the following section.

SECTION XIV.

SPHENO-PALATINE AND OTIC GANGLIA, FACIAL AND NASAL NERVES, AND BRANCHES OF THE INTERNAL MAXILLARY ARTERY.

Branches of Meckel's ganglion;

Branches of Meckel's ganglion. — From the ganglion of Meckel in the spheno-maxillary fossa, branches are furnished to the nose through the spheno-palatine foramen, to the palate through the canals of the same name, and to the facial

nerve along the vidian canal. The position of these several nerves may first be ascertained by examining their channels of transmission in the prepared skull.

Dissection. — The branches of the ganglion that enter the nose will be found on the left part of the sawn skull, by seeking them opposite the spheno-palatine foramen, through which they enter the nasal fossa with corresponding arteries. One of these nerves (naso-palatine), before referred to as lying in the membrane of the septum, is to be isolated from the pituitary membrane, and followed forwards to where it enters the floor of the nose. Branches of the internal maxillary artery accompany the nerves, and are to be dissected with them. Seek branches to the nose,

To lay bare the nerves that descend to the palate, the posterior part of the mucous membrane detached from the septum of the nose, and that lining the nasal fossa behind the spongy bones, should be taken away. After this has been removed, the palatine nerves and vessels will be seen through the thin translucent palate bone, and will be readily reached by breaking carefully through the bone with a chisel. Afterwards the tube of membrane that contains the vessels and nerves is to be opened; and these are to be followed down to the soft palate and roof of the mouth, and then onwards towards the incisor teeth. The palatine nerves will lead upwards to the ganglion, which is close to the body of the sphenoid bone. But to bring the ganglion fully into view, it will be necessary to saw through the overhanging part of the sphenoid bone, to cut away pieces of the bones surrounding the hollow in which it lies, and to remove with care the enveloping fat and the periosteum. The ganglion may be then seen to be a small reddish-looking body, from which the vidian nerve passes backwards. branches to the palate, body of ganglion;

To trace backwards the vidian branch to the carotid plexus and the facial nerve, the student must lay open the canal which contains it in the root of the pterygoid process; and in doing this he must be careful of a small pharyngeal branch of nerve and artery that are superficial to the vidian, and lie in the pterygo-palatine canal. At the back of the pterygoid canal, a small branch from the vidian to the carotid plexus is to be looked for. Lastly, the vidian nerve is to be followed into the skull by cutting away the point of vidian nerve.

the petrous part of the temporal bone, and the internal carotid artery; and is to be pursued on the surface of the temporal bone, beneath the ganglion of the fifth nerve, to the hiatus Fallopii. Its junction with the facial nerve will be seen with the dissection of that nerve. It is rather a troublesome task to trace the nerve through the cartilage in the foramen lacerum (basis cranii).

Ganglion of Meckel. The SPHENO-PALATINE GANGLION (ganglion of Meckel) occupies the spheno-maxillary fossa, close to the spheno-palatine foramen, and is connected with the palatine Situation and connection with spheno-palatine branches. branches of the superior maxillary nerve. The ganglionic mass is somewhat triangular in form, and of a greyish colour. It is situate, for the most part, behind the branches of the superior maxillary nerve to the palate, so as to surround only part of their fibres; and it is prolonged posteriorly into Structure. the vidian nerve. Meckel's ganglion resembles the other ganglionic masses in connection with the fifth nerve in having sensory, motor, and sympathetic offsets or roots connected with it, and in this wise: — its sensory nerve fibres come from the fifth nerve, its motor fibres from the facial nerve through the vidian branch, and its sympathetic fibres are continued from the carotid plexus through the sheath of the vidian.

Branches given The *Branches* of the ganglion are directed upwards to the orbit; downwards to the mouth; inwards to the nose; and backwards to the pharynx, and the facial and sympathetic nerves.

to the orbit; *Branches to the orbit.* — These are two or three in number, which ascend through the spheno-maxillary fissure, and end in the periosteum. It will be necessary to cut through the sphenoid bone to follow these nerves to their termination.

to the palate, *Branches to the palate.* — The nerves of the palate, though connected in part with the ganglionic mass, are the continuation of the spheno-palatine branches of the superior maxillary are three. nerve (p. 106.). Below the ganglion they are divided into three palatine nerves (large, small, and external), which are distributed to the roof of the mouth, the soft palate and tonsil, and the lining membrane of the nose.

Large *a.* The *large palatine nerve* (anterior) reaches the roof of the mouth through the largest palatine canal, and extends forwards nearly to

the incisor teeth, where it joins the naso-palatine nerve. Whilst in its canal, the nerve furnishes two or more filaments (*inferior nasal*) to the membrane on the middle and lower spongy bones; and, in the roof of the mouth, it supplies the mucous membrane and glands, and gives an offset to the soft palate. has branches to nose,

b. The *small palatine nerve* (posterior) lies in the smaller canal, and ends inferiorly in the soft palate and the levator palati muscle; it supplies the uvula and tonsil. small, and

c. The *external palatine nerve* is smaller than the other two, and descends in the canal of the same name. Leaving the canal, the nerve is distributed to the velum palati and the tonsil. external palatine.

Branches to the nose. — The nasal branches, from three to five in number, are for the most part very small and soft, and pass inwards through the spheno-palatine foramen. One of these is the naso-palatine nerve. Their distribution is mentioned below. Nasal branches are

a. The *superior nasal branches* (anterior) are distributed in the mucous membrane on the two upper spongy bones, and a few filaments reach the back part of the septum nasi. Superior nasal,

b. The *naso-palatine nerve* (nerve of Cotunnius) crosses the roof of the nasal fossa to reach the septum nasi, and descends on this partition to near the front. The nerve now enters a special canal, by the side of the septum, that of the left side of the body being anterior to the other, and is conveyed to the roof of the mouth, where it lies in the centre of the anterior palatine fossa. Finally, the nerves of opposite sides are united in the mouth, and are distributed in the mucous membrane behind the incisor teeth; at their distribution they are connected with the great palatine nerves. On the septum nasi filaments are supplied by the naso-palatine nerve to the mucous membrane. To follow the nerve to its termination, the canal in the roof of the mouth ought to be opened. Naso-palatine.

The *posterior branches* are two: a pharyngeal branch, and the vidian nerve. Branches backwards are

a. The *pharyngeal branch* is very small, and is directed through the pterygo-palatine canal to the mucous membrane of the pharynx near the Eustachian tube, in which it ends. to pharynx

b. The *vidian nerve* passes backwards through the vidian canal, and sends some small filaments, through the bone, to the membrane of the back part of the roof of the nose (*upper posterior nasal branches*). At its exit from the canal, the nerve furnishes a soft reddish offset (*carotid branch*) to join the sympathetic on the outer side of the carotid artery. The continuation of the nerve enters the cranium through the cartilaginous substance closing the fora- and the facial sympathetic nerves through the vidian.

men lacerum (basis cranii), and is directed backwards in a groove on the surface of the petrous part of the temporal bone, where it takes the name of *large superficial petrosal nerve*. Lastly it is continued through the hiatus Fallopii, to join the gangliform enlargement on the facial nerve. Whilst in the temporal bone, the vidian receives a twig from the tympanic nerve.

Vidian a compound nerve. The vidian nerve may be considered to consist of motor and sympathetic fibres in the same sheath, these being combined here in the same manner as in the connecting branches between the sympathetic and spinal nerves.

Directions.— The student may now direct his attention to the remaining nerves and vessels that are distributed in the nasal cavity.

Seek other nerves and vessels of nose. *Dissection.* — The nasal nerve is to be sought in the nose behind the nasal bone, by gently detaching the lining membrane, after having cut off the projecting bone. A branch is given from the nerve to the septum nasi, but probably this and the trunk of the nerve will be seen but imperfectly in the present condition of the part. The terminal branches of the internal maxillary artery with its veins in the spheno-maxillary fossa are to be completely traced out.

Nasal nerve The *nasal nerve* (of the ophthalmic) has been already seen in the orbit and skull, and at its termination in the face (p. 47.); and the part that connects the two through the lies beneath nasal bone; gives nose is now to be learned. Entering the nasal fossa by an aperture at the front of the ethmoid bone, the nerve gives a branch to the membrane of the septum of the nose, and is then continued in a groove behind the os nasi to the lower margin of this bone, where it escapes to the surface of the nose.

branch to septum *Branches.*— The *branch to the septum* divides into filaments that ramify on the anterior part of that partition, and reach nearly to the lower border.

and to outer wall. *One* or *two filaments* are likewise furnished by the nerve to the mucous membrane of the fore part of the outer wall of the nasal fossa; these extend as low as the inferior spongy bone.

Branches of internal maxillary artery are *Terminal branches of the internal maxillary artery.* — The branches of the artery in the spheno-maxillary fossa, which have not been hitherto seen, are the following: — superior palatine, naso-palatine, pterygo-palatine, and vidian.

1. The *superior* or *descending palatine* is the largest branch of the artery in the fossa, and accompanies the large palatine nerve in its canal. Arrived at the palate, the vessel is directed forwards in the roof of the mouth, and anastomoses, behind the incisor teeth, with the artery of the opposite side, and with a branch that descends from the nose through the anterior palatine fossa. In its course the artery supplies branches to the other palatine canals, which pass with the contained nerves to the soft palate and tonsil; and some offsets are furnished to the lining membrane of the nose. In the roof of the mouth the mucous membrane, glands, and gums, receive their vessels from this artery. palatine branch,

2. The *nasal* or *spheno-palatine artery* enters the nose through the spheno-palatine foramen, and divides into branches:— Some of these are distributed on the spongy bones and the outer wall of the nasal fossa, and supply offsets to the membrane lining the posterior ethmoidal cells. One long branch, artery of the septum (*art. naso-palatina*), runs on the partition between the nasal fossæ to the anterior palatine canal, through which it anastomoses with the superior palatine in the roof of the mouth. This branch accompanies the naso-palatine nerve, and covers the septum with numerous ramifications. nasal branches, one to septum nasi,

3. The *pterygo-palatine* is a very small branch which, passing backwards through the canal of the same name, is distributed to the Eustachian tube and the lining membrane of the pharynx. pterygo-palatine branch,

4. The *vidian* or *pterygoid branch* is contained in the vidian canal with the nerve of the same name, and ends on the upper part of the Eustachian tube and the pharynx after escaping from its canal. vidian branch.

Some other small *nasal arteries* are furnished to the roof of the nasal fossa by the anterior and posterior ethmoidal branches of the ophthalmic (p. 50.); and near to the nostril by the facial artery. Other nasal arteries.

Veins.— The veins corresponding to the terminal branches of the internal maxillary artery unite in the spheno-maxillary fossa in the *alveolar* plexus. Into this plexus offsets are received from the pterygoid plexus and the infraorbital vein; and from it a large trunk (alveolar, anterior internal maxillary vein) is directed forwards below the malar bone to join the facial vein (p. 30.). Beneath the mucous membrane of the nose these vessels have a plexiform arrangement, which is particularly large over the free margin of the spongy bones. Veins; alveolar plexus.

FACIAL NERVE IN THE TEMPORAL BONE.— This nerve winds through the petrous part of the temporal bone, and it is followed with difficulty, in consequence of the extreme Facial nerve.

density of the bone, and the absence of marks on the surface to indicate its position. To render this dissection easier, the student should be provided with a temporal bone, in which the course of the facial nerve and the cavity of the tympanum are displayed.

Dissection of nerve in bone,

Dissection. — The examination of the nerve is to be begun at the stylo-mastoid foramen, and to be traced inwards from that point. With this view, the side of the skull should be sawn through between the meatus externus and the anterior border of the mastoid process, so as to open the posterior part of the aqueduct of Fallopius. The nerve will then be seen entering deeply into the substance of the temporal bone; and it will be readily followed if the dissector cuts away with the bone forceps all the bone projecting above it. In this last step, the cavity of the tympanum will be more or less opened, and the chain of bones in it laid bare. The nerve is now to be traced onwards along the inner side of the tympanum, till it becomes enlarged, and bends suddenly inwards to the meatus auditorius internus. The surrounding bone is to be removed from the enlargement on the nerve, so as to trace to it the petrosal nerves; and then the meatus auditorius is to be laid open, to see the facial and auditory nerves in that hollow.

of chorda tympani,

The course of the chorda tympani nerve (branch of the facial) across the tympanum will be seen by the removal of the central ear bone, the incus. The nerve may also be traced through the wall of the cavity behind, as well as out of the cavity in front.

and other branches.

The remaining branches of the facial nerve in the bone are very minute, and are not to be seen, unless on a fresh piece of the skull which has been softened in acid. The student may therefore omit all the paragraphs marked with an asterisk, till he is able to obtain a part on which a careful examination can be made.

Facial nerve winds through temporal bone,

The *facial nerve* enters the internal auditory meatus with the auditory nerve. It is then received into the aqueduct of Fallopius at the bottom of the meatus, and is conducted through the temporal bone to the stylo-mastoid foramen and the face (p. 40.). In its serpentine course through the bone, the nerve is first directed outwards to the inner wall of the tympanum: at that spot it suddenly bends backwards, and

is marked by a gangliform swelling (intumescentia gangliformis) to which several nerves are united. From this swelling the nerve is continued through the arched aqueduct, passing along the inner wall of the tympanum, and then behind that cavity to the aperture of exit from the bone. The branches of the nerve in the bone serve for the most part to connect it with other nerves; but one supplies the tongue, and another the stapedius muscle. is marked by swelling which receives many twigs. Other branches.

Connecting branches.—These branches communicate with the auditory and glosso-pharyngeal nerves; also with two trunks (superior and inferior maxillary) of the fifth nerve. Branches joining nerve

* *a. Union with the auditory nerve.*—In the bottom of the meatus the facial and auditory nerves are connected by one or two minute filaments. to auditory nerve,

* *b. Connecting branches of the gangliform enlargement.*—The swelling of the facial nerve receives three small twigs. One in front is the *large superficial petrosal* nerve (vidian); another is the *small superficial petrosal* of the tympanic nerve; and the third is the *external superficial petrosal*, which is derived from the sympathetic on the middle meningeal artery. to superior maxillary, tympanic, and sympathetic,

c. *Chorda tympani.*—This long but slender branch of the facial nerve crosses the tympanum, and ends in the tongue. Arising about a quarter of an inch from the stylo-mastoid foramen, the nerve is directed forwards to the tympanum through a canal in the posterior boundary, and enters that cavity below the pyramid. In the cavity the nerve is directed forwards, across the handle of the malleus and the membrana tympani, to the Glasserian fissure, or an aperture on the inner side of it, through which it leaves the tympanum. Outside the skull the chorda tympani joins the gustatory nerve, and then continues along it to the submaxillary ganglion and the tongue (p. 98.). to gustatory by chorda tympani.

The AUDITORY NERVE will be learned with the ear. It may now be seen to divide into two parts, one of which enters the cochlea, and the other the vestibule. Auditory nerve.

OTIC GANGLION.—At this late period of the dissection, there is little to be seen of this ganglion, but the student should remember that it is one of the things to be examined in a fresh part. Its situation is on the inner aspect of the inferior maxillary nerve, close to the base of the skull, and it must therefore be arrived at from the inner side. To be seen on a fresh part.

Dissection.—Putting the part in the same position as for the examination of Meckel's ganglion, the dissector should Dissection.

define the Eustachian tube and the muscles of the palate, and then take away the levator palati and that tube, using much care in removing the last. When some loose connective tissue has been cleared away, the internal pterygoid muscle comes into view, with the trunk of the inferior maxillary nerve above it, and a small branch (internal pterygoid) descending from that nerve to the surface of the muscle. If this branch of nerve to the pterygoid muscle be taken as a guide, it will lead to the ganglion.

To define ganglion and its branches.

* To complete the dissection, saw vertically through the petrous part of the temporal bone, a little nearer the middle line than the inner wall of the tympanum, the bone being supported whilst it is divided. Taking off now some membrane that covers the ganglion, the student may follow backwards a small branch to the tensor tympani muscle, but he must previously open the small canal that contains the muscle, by entering it from below through the carotid canal. Above this small branch is another minute nerve (small superficial petrosal nerve), that issues from the skull, and joins the back of the ganglion. A small twig is to be sought from the front of the ganglion to the tensor palati muscle, and one, near the same spot, to join the sympathetic nerve on the middle meningeal artery.

Otic ganglion is on inner side of inferior maxillary.

The OTIC GANGLION (gang. auriculare, Arnold) resembles the other ganglia connected with the fifth nerve. It is a small reddish body, which is situate on the inner surface of the inferior maxillary nerve, close to the skull, and surrounds the origin of the nerve to the internal pterygoid muscle. By its inner surface the ganglion is in contact with the Eustachian tube, and at a little distance behind is the middle meningeal artery. In this ganglion, as in the others above referred to, filaments from motor, sensory, and sympathetic nerves are blended. Some twigs are furnished by it to muscles.

Structure.

Branches join it with fifth, sympathetic,

* *a. Connecting branches — roots.*— The ganglion is joined by a fasciculus from the motor part of the inferior maxillary nerve, and is closely united with the branch of that nerve to the internal pterygoid muscle, thus receiving two of its roots, motor and sensory, from the fifth nerve. Its connection with the sympathetic is established by a twig that is received from the plexus on the middle meningeal artery. Further, the ganglion is connected with

the tympanic nerve by means of the small superficial petrosal nerve, that joins the posterior part. and tympanic nerves.

* *b. Branches to muscles.*— Two muscles receive their nerves from the otic ganglion, viz. tensor tympani and circumflexus palati. The nerve to the tensor tympani is directed backwards, and enters the bony canal that contains that muscle. The branch for the circumflexus, arising from the front of the ganglion, may be supposed to be derived from the internal pterygoid nerve. Other branches enter muscles.

The *nerve of the internal pterygoid muscle* is a long slender branch, that arises from the inner side of the inferior maxillary nerve near the skull, and is directed downwards to the deep surface of the muscle. This nerve is joined by a fasciculus from the motor part of the fifth nerve. Nerve of internal pterygoid.

Directions.— The remainder of the left pterygo-maxillary region may be examined on this side of the body.

Section XV.

DISSECTION OF THE TONGUE.

Directions.—The tongue and larynx are to remain connected with each other whilst the student learns the general form, and the structure of the first. Directions.

Dissection.— The ends of the extrinsic lingual muscles that have been detached, may be cut off, but enough of each should be left to trace it afterwards into the substance of the tongue. Dissection.

The TONGUE occupies the floor of the mouth, and is rather ovoidal in shape, with the larger end turned backwards. It is free over the greater part of the surface; but at the hinder part, and at the posterior two-thirds of the under surface, it gives attachment to the muscles and the mucous membrane that fix it to the parts around. Tongue. Situation and form.

The apex or tip of the tongue is in contact with the incisor teeth; and the base, which looks towards the pharynx, is attached to the hyoid bone, and is likewise connected with the epiglottis by three folds of mucous membrane—a central and two lateral. The upper surface or dorsum of the tongue is somewhat convex, and is received into the hollow of the roof of the mouth; in the anterior two thirds it is divided Connections of apex, base. Upper surface.

into two equal parts by a median groove, which ends a little in front of a hollow named foramen cæcum. This surface is rough and covered with papillæ over the anterior two thirds; but is smoother at the posterior third, though even here the surface is irregular, in consequence of projecting muciparous glands. The under surface, free only in part, gives attachment to the mucous membrane, and to the different lingual muscles that are connected with the hyoid bone and the jaw; and in front of these muscles is the fold of the mucous membrane named frænum linguæ. The borders of the tongue are thick and round at the base of the organ, where they are marked by vertical ridges and furrows, but gradually become thinner near the apex.

Under surface.

Borders.

Kinds of papillæ;

Papillæ.—On the dorsum of the tongue are the following kinds of papillæ; the conical and filiform, the fungiform, and the caliciform.

conical and filiform, situation in middle of tongue;

The *conical* and *filiform* papillæ are the numerous small projections, like the villi on the mucous membrane of the small intestine, that cover the anterior two thirds of the dorsum of the tongue. Some of the papillæ (conical) are wider at their attached than at their free end, and these are most developed over the central part of the tongue. Others become longer (filiform), especially towards the sides of the tongue. These small papillæ are covered with secondary minute hair-like processes; and towards their limit behind, as well as on the side of the tongue, they have a linear arrangement.

fungiform mostly at tip and sides;

The *fungiform* papillæ are less numerous but larger than the preceding set, amongst which they are scattered. They are wider at the free end than at the part fixed to the tongue, and they project beyond the other set; they are mostly situate at the tip and sides of the tongue. The free or larger end is covered with small filamentous projections.

caliciform, near root of tongue; form;

The *caliciform* (papillæ vallatæ) are fewer in number and larger than the others, and are placed at the junction of the two anterior with the posterior third of the tongue. Their number varies from eight to ten. These papillæ extend across the tongue in a line resembling the letter V. Each papilla consists of a central truncated part of a conical form, which is surrounded by a fold of the mucous membrane: its wider part or base projects above the surface, whilst the

apex is attached to the tongue. Both the papilla and the surrounding fold are furnished with smaller secondary papillæ. marked by other papillæ.

Minute simple papillæ exist in the part of the tongue behind the caliciform kind; but they cannot be observed till the epithelium is removed.*—(Todd and Bowman.) Secondary papillæ.

Structure of the papillæ. — The *simple* papillæ are constructed like those of the skin, viz. of a projecting cone of formative membrane, which is covered by epithelium, and filled with a loop of the capillaries, and a loop of a nerve. The three other *compound* forms of the papillæ may be said to be formed by outgrowths from the simple kind. Thus smaller papillary eminences spring from the common elevation of limiting membrane; and each has its separate investment of epithelium, by which the brush-like appearance on the surface is produced. From the plexus of capillary vessels in the interior of the papilla a looped offset is furnished to each smaller papillary projection; whilst the entering nerve sends offsets to the different subdivisions of the papilla, whose mode of ending in each is unknown, though Professor Kölliker thinks he has seen it in the form of a loop, like that of the vessels. Structure of papillæ. Of simple. Of compound.

STRUCTURE. — The tongue consists of two symmetrical halves, and separating them is a fibrous structure in the middle line. Each half is made up of a mass of muscular fibre with interspersed fat; and entering it are the lingual vessels and nerves. The whole tongue is enveloped by the mucous membrane, and a special fibrous membrane attaches it to the hyoid bone. Parts found in tongue.

Dissection. — By the time the student has arrived at this stage, the muscular fibres may have lost their colour; but, with a fresh part, the facts here stated can be easily ascertained. Tongue best seen on fresh part.

To define the septum, and the membrane attaching the tongue to the hyoid bone, the tongue is to be placed on its dorsum, and, the remains of the mylo and genio-hyoideus having been removed, the genio-hyo-glossi muscles are to be cleaned, and drawn from one another along the middle line. Define septum;

* Similar papillæ are said, by Mr. Salter, to occupy "the whole of the under surface of the free portion of the tongue." — *Cyclop. of Anatomy;* art. TONGUE.

After separating these muscles, except in front, and cutting across their intercommunicating fibres, the edge of the septum will appear; and by tracing then the hinder fibres of the two muscles towards the os hyoides, the hyo-glossal membrane will be arrived at; but the membrane will be more completely denuded by cutting through the anterior fibres of the left hyo-glossus. At the front of the tongue the genio-hyo-glossus will be afterwards followed out.

hyo-glossal membrane

Outside this triangular muscle in the middle line, is the longitudinal bundle of the inferior lingualis, which may be cleaned on the left side, though it will subsequently be better seen on the right half.

and inferior lingualis.

Fibrous tissue.—Along the middle line of the tongue is a thin lamina of this tissue, forming a septum; at the root is another fibrous structure, named the hyo-glossal membrane; and covering the organ, for the greater part, is a submucous layer of the same tissue.

Fibrous structures in tongue;

a. Septum.—This fibrous structure forms a vertical partition between the two halves of the tongue, and extends from the base to the apex. It is stronger posteriorly than anteriorly, and is connected behind with the hyo-glossal membrane. To each side the transverse muscle is connected. Its disposition may be better seen, subsequently, on a vertical section. In some instances a small fibro-cartilage about a quarter of an inch deep and of the same length exists in the septum.

its septum.

Fibro-cartilage.

b. The *hyo-glossal membrane* is a thin, but strong fibrous lamina, that attaches the root of the tongue to the upper border of the body of the hyoid bone. On its under or anterior surface some of the hinder fibres of the genio-hyo-glossi are collected, as if this was their aponeurosis to attach them to the os hyoides.

Hyo-glossal membrane.

c. The *submucous fibrous* or aponeurotic *stratum* of the tongue invests the organ, and is continued into the sheaths of the muscles. Over the posterior third of the dorsum its strength is greater than elsewhere; and in front of the epiglottis it forms bands in the folds of the mucous membrane in this position. Into it the muscular fibres are inserted, that end on the surface of the tongue.

Submucous aponeurosis.

Muscles.—Each half of the tongue is made up of extrinsic and intrinsic muscles. The former are distinguished

Muscles in each half.

by having only their termination in the tongue; and the latter, by having both origin and insertion within the organ, — that is to say springing from one part, and ending at another. Two kinds.

A. The *extrinsic muscles* are the following, viz., palato and stylo-glossus, hyo and genio-hyo-glossus, and pharyngeo-glossus. Only the lingual endings of these are now to be noticed, for the origin from the bones around have been before made out. Extrinsic; number.

Dissection. — After the tongue has been firmly fastened on its left side, the extrinsic muscles may be dissected on the right half. Three of these muscles, viz., palato, stylo, and hyo-glossus, come together to the side of the tongue, at the junction of the middle and posterior third; and, to follow their radiating fibres forwards, it will be necessary to remove the mucous membrane from the dorsum and the under surface, between the tip and the point at which they come in contact with the border. On the dorsum of the tongue a thin muscular stratum, that is superficial to these fibres, is to be taken away with the mucous membrane; and beneath the tip, a junction between the stylo-glossus muscles of opposite sides is to be traced. Dissection of palato- and stylo-glossus.

Only the two parts of the hyo-glossus (basio and cerato-glossus, p. 101.), that arise from the body and great wing of the hyoid bone, are referred to above. To lay bare its third part, or the chondro-glossus, the other two portions of the muscle must be cut through with the lingual vessels, and raised and shown entering the tongue. The origin of this small muscular slip, two to three lines in width, can now be seen close to the small cornu of the os hyoides, but it is concealed farther by some fibres of the genio-hyo-glossus that ascend to the upper constrictor; and its radiation, near the upper surface of the tongue, will be prepared by taking the mucous membrane, and the thin underlying muscular stratum, from the remaining third of the dorsum. Of hyo-glossus.

The part of the constrictor muscle that is attached to the tongue, and the ending of the genio-hyo-glossus, come into view through the division of the hyo-glossus. Of constrictor muscle.

The *palato* and *stylo-glossus* are partly combined at their attachment to the lateral part of the tongue, and form, together with the following muscle, an expansion that covers Combined palato and stylo-

glossus position and extent. Fibres. the three anterior fourths of the dorsum, beneath the superficial lingualis. In this muscular stratum the fibres radiate from the point of contact of the muscles with the tongue, — some passing almost horizontally inwards to the centre, and others obliquely forwards to the tip of the organ.

Rest of stylo-glossus joins fellow. A great portion of the stylo-glossus is directed along the side of the tongue, and some fibres are inclined in front of the hyo-glossus, to the under surface, to join those of the opposite muscle beneath the tip.

Hyo-glossus; super-ficial parts; mode of ending. *Hyo-glossus.* — The two superficial parts of the muscle (basio and cerato-glossus, p. 101.) enter the under surface of the tongue, between the stylo-glossus and the lingualis. After entering that surface by separate bundles, they are bent round the margin of the tongue, and then form, with the two preceding muscles, a stratum on the dorsum, whose disposition and extent have been before stated.

Deeper part or chondro-glossus, origin, connec-tions ending in the tongue. The third part of the muscle, or the *chondro-glossus*, is distinct from the rest at its origin, and is separated from them higher up by a slip of the genio-hyo-glossus, and by the lingual vessels. About two or three lines wide at its *origin* from the root of the small cornu, and from part of the body of the os hyoides, the muscle is directed upwards and forwards to the root of the tongue beneath the hinder fibres of the genio-hyo-glossus. In entering the tongue the fibres spread out beneath the upper lingualis, passing obliquely inwards and forwards over the posterior third of the dorsum, and extend as far as the hyo-glossus, with which they become blended.

Muscu-lar cortex of tongue. *Cortex of the tongue.* — The muscles above described, together with the superficial lingualis, constitute a cortical layer of oblique and longitudinal fibres, that covers the tongue, except below where some muscles are placed, and resembles "a slipper turned upside down."* This stratum is pierced by the deeper fibres.

Ar-range-ment in the tongue; The *genio-hyo-glossus* enters the tongue vertically on the side of the septum, and perforates the cortical covering to end in the submucous tissue. In the tongue the fibres

* This apt simile has been used by Mr. Zaglas in an accurate paper on the muscular structure of the tongue. See *Annals of Anatomy and Physiology*, Part I., by Mr. Goodsir. Edin. 1850.

spread like the ribs of a fan from apex to base, and are collected into laminæ as they pass through the transversalis. The most posterior fibres end on the hyo-glossal membrane and the hyoid bone; and a slip is continued from them, beneath the hyo-glossus, to the upper constrictor of the pharynx. A vertical section at a future stage will show the radiation of its fibres. its posterior fibres.

The *pharyngeo-glossus* (glosso-pharyngeus), or the part of the upper constrictor attached to the side of the tongue, passes amongst fibres of the stylo and hyo-glossus, and entering into the lingual substance, is continued with the transverse muscle to the septum. Constrictor at the tongue, how ends.

B. The *intrinsic muscles* are three in number in each half of the tongue, viz. transversalis, with a superior and an inferior lingualis. Number and names of these.

Dissection.—To complete the preparation of the inferior lingualis, on the right side, the fibres of the stylo-glossus covering it in front, and those of the genio-hyo-glossus over it behind, are to be cut through. The superior lingualis may be shown, on the left side, by taking only the mucous membrane from the upper surface from tip to base. The transversalis may be laid bare, on the right side, by cutting away, on the upper aspect, the stratum of the extrinsic muscles already seen; and on the lower aspect, the inferior lingualis and the genio-hyo-glossus. First complete inferior, then superior lingualis, then transversalis.

The nerves for the supply of the tongue should be traced on the left half as well as the part will admit; but a separate recent specimen would be required to follow these satisfactorily. Trace the nerves.

The *transversalis* muscle forms an almost horizontal layer in the substance of the tongue from base to apex. The fibres are attached internally to the side of the septum, and are thence directed outwards, the posterior being somewhat curved, to their insertion into the side of the tongue. Its fibres are collected into vertical plates, so as to allow the passage between them of the ascending fibres. This is horizontal. Attachments. Fibres.

The *superior lingualis* (noto-glossus of Zaglas *) is a thin layer of oblique and longitudinal fibres close beneath the This is superficial.

* The description given by this author I find more correct than that of others.

Origin. submucous tissue on the dorsum of the tongue. Its fibres arise from the frænum epiglottidis, and from the fascia along Fibres. the middle line; from this attachment they are directed obliquely outwards, the anterior becoming longitudinal, to the margin of the tongue, at which they end like they began. Ending. This is the most superficial lingual muscle, and assists in forming the cortex.

Position below tongue. The *inferior lingualis* is much stronger than the preceding, and is placed below the tongue, between the hyo and genio-Origin. hyo-glossus. The muscle arises posteriorly from the fascia on the dorsum, near the root of the tongue *; and the fibres are collected into a roundish bundle in the position before Ending. noted. From its attached surface bundles are continued vertically through the transverse fibres upwards to the dorsum; and at the anterior third of the tongue, where the muscle is overlaid by the stylo-glossus, some of the fibres are applied to that muscle, and distributed with them.

Perpendicular fibres, Some *perpendicular* fibres, distinct from those of the genio-hyo-glossus, are said by anatomists to occupy more or less of the middle line of the tongue. A few of these appear to be present in the apex of the tongue, where they pass where present. from the upper to the lower surface, and through them the fasciculi of the transverse muscle are transmitted.

Mucous membrane; The *mucous membrane* is a continuation of that lining the mouth, and is provided with a laminar epithelium: partly investing the tongue, it is reflected off at different points in the form of folds (p. 140.). At the epiglottis are three small *glosso-epiglottid* folds, connecting this to the root of the tongue; the central one of these is called the frænum of the its epithelium, epiglottis. Like the membrane of the mouth, it is furnished with numerous muciparous glands, and some follicles.

follicles, The *follicles* occupy the dorsum of the tongue, especially between the papillæ vallatæ and the epiglottis, where they form a continuous stratum, some projecting under the mucous membrane.

and glands at the base, The *glands* (lingual) are compound in structure similar to those of the lips and cheek, and are placed mostly beneath the mucous membrane and follicles covering the posterior third of the dorsum of the tongue. A few are found in front

* The fibres are sometimes continuous with the small chondro-glossus.

of the caliciform papillæ, where they project into the muscular substance. Some ducts open on the surface, and others into the hollows around the large papillæ, or even into the foramen cæcum. Opposite the papillæ vallatæ, at the margin of the tongue, is another small collection of submucous glands. Under the tip of the tongue, on each side of the frænum, is a collection of the same kind of glands, from which several ducts issue. at the side, and beneath tip.

NERVES. — There are three nerves distributed in each half of the tongue, viz. the gustatory, the hypoglossal, and the glosso-pharyngeal. Nerves from three sources,

The *gustatory nerve* gives upwards filaments to the muscular substance, and to the two smallest sets of papillæ, conical and fungiform; it joins also the hypoglossal nerve. The *hypoglossal nerve* is spent in long slender filaments that are furnished to the muscular substance of the tongue. The *glosso-pharyngeal* nerve divides into two branches near the border of the tongue: — One turns to the dorsum, and ends in the mucous membrane behind the foramen cæcum. The other passes beneath the side of the tongue, and divides into filaments that enter the muscular substance; it supplies the papillæ caliciformes, as well as the mucous membrane covering the lateral part of the tongue. gustatory, hypoglossal, and glosso-pharyngeal.

VESSELS. — The arteries are derived chiefly from the lingual artery of each side; these, together with the veins, have been examined (p. 102.). After supplying the muscular substance the vessels enter the papillæ, and end in loops as before said. Arteries and veins.

SECTION XVI.

DISSECTION OF THE LARYNX.

The LARYNX is the upper dilated part of the air tube, in which the voice is produced. This organ of the voice is constructed of several cartilages, which are united together by ligamentous bands; of muscles for the movement of the cartilages; and of vessels and nerves. The whole is lined by mucous membrane. Outline of larynx.

Dissection. — The tongue may be now removed from the larynx by cutting through its root, but this is to be done without injuring the epiglottis. The parts that are to be described would be much better seen on a fresh larynx. Dissection.

Occupying the middle line of the neck, the larynx is Situa-

tion and connections. placed in front of the pharynx, and between the carotid vessels. It is pyramidal in form. Its base is turned upwards, and is attached to the hyoid bone, and to it the epiglottis is connected; whilst its apex is directed downwards, and is continuous with the trachea. The front is prominent along the middle line of the neck; and the posterior surface is covered by the mucous membrane of the pharynx. The larynx is very moveable, and during deglutition is elevated and depressed by the different extrinsic muscles that are connected with it and the hyoid bone.

Is very moveable.

Six special muscles of larynx.

MUSCLES. — The special muscles of the larynx pass from one cartilage to another, and modify by their action the state of the vocal apparatus. Commonly six muscles are described, but the number is stated differently by anatomists. Three are outside the cartilages, and three are more or less concealed by the thyroid cartilage; most of them are in pairs, and alike on the two sides of the body.

Directions.—On one side of the larynx, say the right, the muscles may be dissected, and on the opposite side the nerves and vessels; and those superficial muscles are to be first learnt, that do not require the cartilages to be cut.

Dissection of the external set of muscles.

Dissection. — The larynx should be first extended, and when it has been fastened in that state with pins, the dissector may clear away from the os hyoides and the thyroid cartilage the following extrinsic muscles that are inserted into them, viz. the constrictor, sterno-hyoid, sterno-thyroid, and thyro-hyoid. In front, between the thyroid and cricoid cartilages, one of the three small external muscles, — crico-thyroid, will be seen. The other two external muscles are situate at the posterior aspect of the larynx: to denude them it will be necessary to turn over the larynx, and to remove the mucous membrane covering it. On the back of the cricoid cartilage the dissector will find the crico-arytænoideus posticus muscle; and above it, on the posterior part of the arytænoid cartilages, the arytænoid muscle will appear.

Crico-thyroideus is small.

The CRICO-THYROIDEUS MUSCLE is triangular in form, and is separated by an interval from the one of the opposite side. It *arises* from the front and the lateral part of the cricoid cartilage, and its fibres ascend, diverging from one another, to be *inserted* into the small cornu, and the lower border of the thyroid cartilage as far forwards as a quarter of an inch

from the middle line; also, for a short distance (a line), into the inner surface of that cartilage. The muscle rests on the crico-thyroid membrane, and is concealed by the sterno-thyroid muscle.

The CRICO-ARYTÆNOIDEUS POSTICUS MUSCLE lies on the posterior part of the cricoid cartilage. Its *origin* is from the depression on the side of the vertical ridge at the posterior aspect of that cartilage. From this origin the fibres are directed outwards, and converge to be *inserted*, by fleshy and tendinous fibres, into a projection at the outer part of the base of the arytænoid cartilage.

Crico-arytænoideus posticus is on back of cricoid cartilage.

The ARYTÆNOIDEUS is a single muscle in the middle line, and is placed in the concavity on the posterior aspect of the arytænoid cartilages. Two sets of fibres with different directions, viz. superficial and deep, are present in the muscle. The deep fibres are transverse; they are inserted into the outer border and the posterior surface of the cartilages, and close the interval between the cartilages. The superficial fibres consist of two oblique fasciculi, which cross like the parts of the letter X, each passing from the base of one cartilage to the apex of the other. A few of the oblique fibres of the muscle are usually continued round the cartilage to join the thyro-arytænoid muscle, or to blend with the fibres in the arytæno-epiglottidean fold of mucous membrane.

Arytænoideus; deep or transverse fibres, superficial or oblique.

Dissection. — To bring into view the remaining muscles, which are somewhat concealed by the thyroid cartilage, it will be necessary to remove the right half of the thyroid, by cutting through it near the middle line, after its small cornu has been detached from the cricoid cartilage. By the removal of a little connective tissue, the dissector will define inferiorly the lateral crico-arytænoid muscle; above it, the thyro-arytænoideus muscle; and still higher, the thin muscular fibres (depressor of the epiglottis) in the fold of mucous membrane between the epiglottis and the arytænoid cartilage.

Dissection of internal muscles.

The CRICO-ARYTÆNOIDEUS LATERALIS is a small lengthened band, which *arises* from the lateral part of the upper border of the cricoid cartilage; its fibres are directed backwards to be *inserted*, with the thyro-arytænoid muscle, into a projection on the outer side of the base of the arytænoid carti-

Lateral crico-arytænoideus

lage, as well as into the contiguous part of the cartilage on the anterior or outer aspect. This muscle is concealed by the crico-thyroideus, and its upper border is contiguous to the succeeding muscle.

is beneath thyroid cartilage.

Thyro-arytænoideus.

The THYRO-ARYTÆNOIDEUS MUSCLE extends backwards in the interior of the larynx from the thyroid to the arytænoid cartilage; it is thick below, but thin and expanded above. The muscle *arises* from the thyroid cartilage near the middle line, for about the lower half of the depth, and from the crico-thyroid ligament. The fibres are directed backwards, with different inclinations;—the external ascend somewhat, and are inserted into the upper part of the arytænoid cartilage on the anterior and outer aspect; the internal and lower fibres are transverse, and form a thick bundle, which is inserted into the fore part of the base of that cartilage, as well as into the outer surface; and some fibres are attached to the vocal cord. By its outer aspect the muscle is in contact with the thyroid cartilage; and the inner surface rests on the vocal cords, and on the ventricle of the larynx and its pouch.

Some fibres ascend to tip, others go to base of arytænoid cartilage.

Connections.

Depressor of epiglottis double origin.

The DEPRESSOR OF THE EPIGLOTTIS (reflector epiglottidis, thyro-arytæno-epiglottideus) is the thin muscular layer, which is contained in the fold of mucous membrane bounding laterally the upper opening of the larynx. Its fibres *arise*, posteriorly, from the front and upper part of the arytænoid cartilage, some being continuous with the oblique fibres of the arytænoid muscle; and a fasciculus (thyro-epiglottideus) is attached, anteriorly, to the inner surface of the thyroid cartilage. From this origin the fibres turn upwards with very different directions, and are *inserted* into the border of the epiglottis. The strength of this muscle varies much in different bodies.

Insertion.

Some of the lower fibres of this muscle, that cover the top of the laryngeal pouch, have been described by Mr. Hilton* as a separate muscle, and named *compressor sacculi laryngis.*

Parts inside larynx.

PARTS INSIDE THE LARYNX.—The laryngeal cartilages are so arranged as to enclose a space, and defend the parts more immediately concerned in the production of the voice, viz. the vocal cords, the glottis, and the ventricle of the larynx and its pouch.

* See No. 5. of Guy's Hospital Reports.

Dissection.—For the purpose of displaying the vocal apparatus, let the tube of the larynx be divided along the posterior part; and in cutting through the arytænoid muscle, let the incision be rather to the right of the middle line, so as to avoid the nerves that enter it. On looking into the larynx a hollow (ventricle) will be seen on each side; and if a probe be passed into the hollow or ventricle it may be made to enter a small pouch by an aperture in the anterior and upper part. The dissector should fill the pouch on the right side by introducing very small and round bits of cotton wool into it. Bounding the ventricle above and below are the bands of the vocal cords. Dissection to expose them.

The *laryngeal space* reaches from the aperture behind the epiglottis to the lower border of the cricoid cartilage. At the upper part, the space that corresponds to the large interval between the alæ of the thyroid cartilage is much diminished in size by the thyro-arytænoid muscles and the vocal cords, and only a narrow interval, the glottis, is left at one spot. At the lower part, however, the space remains of the same shape and size as the cricoid cartilage, and is therefore circular, and larger than the narrow part before alluded to. Space partly filled, producing glottis. The rest large.

The *upper orifice* of the larynx will be seen by placing in contact the surfaces of the cut along the posterior part. It is triangular in shape, with the base in front and the apex behind, and its sides are sloped obliquely downwards in the antero-posterior direction. Its boundaries are,—the epiglottis in front, the arytænoid muscle and cartilages behind, and the arytæno-epiglottidean fold of mucous membrane on each side. This aperture is closed by the epiglottis during deglutition. Upper orifice shape, and boundaries.

The *glottis,* or *rima glottidis,* is the interval between the lower vocal cords; it is placed on a level with the base of the arytænoid cartilages, and is the narrowest part of the laryngeal cavity. In the state of rest it is a narrow fissure enlarged a little and rounded behind, but when dilated it is triangular in form, like the upper orifice, though its wider part is turned backwards to the arytænoid muscle. Its sides are not constructed wholly of a yielding material, but partly of ligament and partly of cartilage:—thus, for about the two anterior thirds is the elastic vocal cord, whilst, at the Glottis, position, form, construction,

posterior third is the smooth inner surface of the arytænoid cartilage. The size of the interval differs in the two sexes: In the male it measures from before back nearly an inch (less a line), and across at the base when dilated, about a third of the other measurement. In the female the dimensions will be less by two or three lines.

size differs.

Changes in size, in two ways.

Alterations in the size and form affect the interval where it is bounded by the cartilages, as well as where it is limited by the ligament. In the former part, the changes are occasioned mostly by the rotation of the arytænoid cartilages around their axis; but in the latter they are due to the lengthening or shortening of the bands, or to their yielding, as in the passage of an instrument. In the living body the muscles are constantly producing alterations in the fissure, some acting more immediately on the cartilages so as to be dilators or contractors of its base; and others acting on the ligaments, and thereby elongating and shortening the sides. The base is enlarged, and the interval rendered triangular by the posterior crico-arytænoid; and is diminished by the arytænoid, and the lateral crico-arytænoid. And the sides are elongated and made tense by the crico-thyroid; but shortened by the thyro-arytænoid. In inspiration the fissure is slightly larger than in expiration.

Action of the muscles, on base, on sides.

Ventricle. Situation. Parts around.

The *ventricle* of the larynx is the oval hollow, on each side, between the vocal cords. The upper margin of the opening is semilunar, and the lower is straight. On the outer surface are the fibres of the thyro-arytænoid muscle, and in the anterior part is the aperture into the laryngeal pouch.

Pouch of larynx. Form and position. Surrounding parts.

The *laryngeal pouch* (sacculus laryngis) will be best seen by removing, still on the right side, the thyro-arytænoid muscle, and some fibrous tissue that covers it. It is a small membranous sac, half an inch deep and cylindrical in form, which projects upwards between the thyro-arytænoid muscle and the upper vocal cord, and reaches sometimes as high as the upper border of the thyroid cartilage. Its cavity communicates with the front of the ventricle by a narrow aperture, provided mostly with two folds of mucous membrane. On the outer surface are numerous small glands, whose ducts are transmitted through the coats of the sac to the inside. Numerous nerves are distributed over the sac.

Its upper part is covered by the muscular slip before referred to (p. 166.).

Dissection. — The mucous membrane should be removed on the right side from the two whitish bands of the vocal cords (thyro-arytænoid ligaments), that bound the ventricle of the larynx above and below. Then the lateral crico-arytænoid muscle, and any fibres that may remain of the thyro-arytænoideus should be taken away. Dissection.

The *thyro-arytænoid ligaments*, or the vocal cords, are two bands on each side, which are extended from the angle of the thyroid to the arytænoid cartilage, — one forming the upper, the other the lower margin of the ventricle; they are about seven lines long in man, and two less in the woman. Thyro-arytænoid ligaments.

a. The *inferior ligament* (chorda vocalis) is a band of fine elastic tissue, which is almost transverse in direction. Attached in front to the angle of the thyroid cartilage, about half way down below the notch, the fibres of the ligament are directed backwards parallel to one another, and are inserted into the anterior prominence at the base of the arytænoid cartilage. Internally this band is covered only by thin mucous membrane, and projects towards its fellow into the cavity of the larynx, the interval between it and the opposite one being the glottis; externally it is connected with the thyro-arytænoid muscle; and inferiorly it is continuous with the crico-thyroid membrane. The edge that bounds the ventricle is straight and well defined, and vibrates to produce sounds. Inferior or vocal cord has these connections.

b. The *upper ligament* (false vocal cord) is semilunar in form, and is much weaker than the preceding one. It is fixed in front to the angle of the thyroid cartilage, near the attachment of the epiglottis; and behind to the rough outer surface of the arytænoid cartilage. This ligament contains chiefly fibrous tissue in its interior, which is continuous with that in the arytæno-epiglottidean fold of mucous membrane. Upper ligament is a very slight band.

The *mucous membrane* of the larynx is derived from that investing the pharynx, and is prolonged to the lungs through the trachea. When entering the larynx it is stretched between the epiglottis and the tip of the arytænoid cartilage, forming the arytæno-epiglottidean fold on each side of the Mucous membrane.

laryngeal orifice: in this spot it is very loose, and the submucous tissue abundant. In the larynx the membrane closely lines the cavity, sinks into the ventricle, and is prolonged into the laryngeal pouch. On the thyro-arytænoid ligaments it is very thin and adherent, allowing these to be visible through it.

Epithelium has different nature. A columnar ciliated epithelium covers all the surface below the superior vocal cords, and is continued anteriorly in the adult to the root of the epiglottis (Kölliker). In the part of the larynx above the line mentioned, the epithelium is of the laminar kind.

Glands. Numerous *muciparous glands* are connected with the mucous membrane of the larynx; and the orifices will be seen on the surface, especially at the posterior aspect of the epiglottis. In the edge of the arytæno-epiglottidean fold there is a little swelling occasioned by a mass of subjacent glands (arytænoid), and a small fibro-cartilaginous body. None exist over the vocal cords.

Dissection of nerves. *Dissection.*—The course of the laryngeal nerves in the neck has been already traced, and their termination in the larynx may be dissected on the untouched side. For this purpose the other half of the thyroid is to be disarticulated from the cricoid cartilage; and care should be taken of the recurrent nerve, which lies near the junction between the two. The trachea and larynx should next be fastened down with pins, and after the thyroid has been drawn away from the cricoid cartilage, the inferior laryngeal nerve can be traced over the side of the latter cartilage to the muscles of the larynx, and the mucous membrane of the pharynx. Afterwards the superior laryngeal is to be followed to the mucous membrane of the interior of the larynx, and to that of the pharynx. Two communications are to be found between these nerves; one is beneath the thyroid cartilage, the other in the mucous membrane of the pharynx. An artery accompanies each nerve, and is to be dissected at the same time.

Nerves are from vagus. NERVES.—The nerves that supply branches to the larynx, are the superior and inferior laryngeal branches of the pneumo-gastric nerve (p. 117.); the former is distributed to the mucous membrane, and the latter to the muscles.

Recurrent nerve a. The *inferior laryngeal* nerve (recurrent), when about to enter the larynx, furnishes backwards an offset to the mucous mem-

brane of the pharynx, which joins with filaments from the upper laryngeal nerve. The nerve then passes beneath the ala of the thyroid cartilage, and ends in branches for all the special muscles of the larynx, except the crico-thyroideus. Its small muscular branches are easily followed, but that to the arytænoid muscle passes beneath the crico-arytænoideus posticus. Beneath the thyroid cartilage this nerve is joined by a long offset of the upper laryngeal nerve. supplies special muscles except one.

b. The *superior laryngeal* nerve pierces the thyro-hyoid ligament, and gives offsets to the mucous membrane covering the back of the larynx; it furnishes also a long branch, beneath the ala of the thyroid cartilage, to communicate with the recurrent nerve. The trunk of the nerve then terminates in many branches for the supply of the mucous membrane: — Some of these ascend in the arytæno-epiglottidean fold of that membrane to the epiglottis, and the root of the tongue. The others, which are the largest, descend on the inner side of the ventricular pouch, and supply the lining membrane of the larynx as low as the vocal cords. One nerve of this set pierces the arytænoid muscle, and appears (?) to supply it. Superior laryngeal nerve joins recurrent, and ends in mucous membrane.

VESSELS. — The arteries of the interior of the larynx are furnished from the superior and inferior thyroid branches (p. 84, 75.). Arteries

a. The *laryngeal branch* of the *superior thyroid artery* enters the larynx with the superior laryngeal nerve, and divides like it into ascending and descending branches; some of these enter the muscles, but the rest supply the mucous membrane of the epiglottis, and that of the root of the tongue and the interior of the larynx. It anastomoses with the following artery both beneath the ala of the thyroid cartilage, and in the mucous membrane of the pharynx. from superior thyroid;

b. The *laryngeal branch* of the *inferior thyroid artery* ascends on the back of the cricoid cartilage, and supplies the mucous membrane of the pharynx and the muscles of the larynx, like the nerve. from inferior thyroid

c. Some other twigs from the inferior thyroid artery perforate the crico-thyroid membrane, and end in the mucous lining of the interior of the larynx at the lower part. two sources.

Veins. — The vein that accompanies the branch of artery from the superior thyroid, joins the internal jugular or the superior thyroid vein; whilst the vein corresponding to the other artery opens into the plexus connected with the inferior thyroid veins (p. 84, 127.). Veins end differently.

Section XVII.

HYOID BONE, CARTILAGES AND LIGAMENTS OF THE LARYNX, AND STRUCTURE OF THE TRACHEA.

Dissection.

Dissection. — All the muscles and the mucous membrane are to be taken away so as to denude the hyoid bone, the cartilages of the larynx, and the epiglottis; but the piece of membrane that joins the hyoid bone to the thyroid cartilage, and the ligaments uniting one cartilage to another, should be left with care. In the arytæno-epiglottidean fold of mucous membrane, a small fibro-cartilaginous body (cuneiform cartilage) should be sought: an oblique projection indicates its position.

Hyoid bone. Form.

The *hyoid bone* (os hyoides) is situate between the larynx and the root of the tongue. Resembling the letter U, placed horizontally and with the legs turned backwards, it offers for examination a central part or body, and two side pieces or cornua.

Body of the bone.

The body is flattened, and measures most in the vertical direction. Convex in front, where it is marked by a tubercle, it presents an uneven surface for the attachment of muscles; whilst on the opposite aspect it is concave. To the upper border the fibrous membrane (hyo-glossal) fixing the tongue is attached.

Side pieces, large

The cornua are two in number on each side (large and small). The *large* cornu continues the bone backwards, and is joined to the body by a surface covered with cartilage. The surfaces of this cornu look somewhat upwards and downwards; and the size decreases from before backwards. It ends posteriorly in a tubercle.

and small.

The *small* cornu, or appendix, is directed upwards from the point of union of the great cornu with the body, and is joined by the stylo-hyoid ligament. It is seldom wholly ossified.

There are four large

Cartilages of the Larynx. — There are four large cartilages in the larynx, which are concerned in the production of the voice, viz. the thyroid, the cricoid, and the two arytænoid.

and some small cartilages.

In addition there are some fibro-cartilaginous structures called yellow cartilage, viz. the epiglottis, a capitulum to each arytænoid cartilage, and on each side a small

roundish piece (cuneiform) in the arytæno-epiglottidean fold of mucous membrane.

The *thyroid cartilage* is the largest of all: it forms the upper part of the larynx, and protects the vocal apparatus as with a shield. The upper part of this cartilage is considerably wider than the lower, and in consequence of this the form of the larynx somewhat resembles a funnel. The anterior part is prominent in the middle line, forming the subcutaneous swelling named *pomum Adami;* but the cartilage is concave behind, at the same spot, and gives attachment to the epiglottis and the thyro-arytænoid muscles and ligaments. The upper border is notched in the centre.

Thyroid cartilage is convex in front, concave behind.

The cartilage consists of two square parts or halves, which are united in the middle line. Posteriorly each half of the cartilage has a thick border, which terminates upwards and downwards in a rounded projection or cornu, both of which are bent slightly inwards: of the two, the upper cornu is the longest; but the lower cornu is thicker than the other, and articulates with the cricoid cartilage. The inner surface of each half is smooth; but the outer is marked by an oblique line, that extends from a tubercle near the root of the upper cornu, nearly to the middle of the lower border.

Formed of two halves, each having borders and cornua.

The *cricoid cartilage* is stronger though smaller than the thyroid; it is partly concealed by the shield-like cartilage, below which it is placed, and encircles the cavity of the larynx. It is very unequal in depth before and behind, the posterior part being three times deeper than the anterior, something like a signet ring.

Cricoid cartilage.

Form.

The outer surface is rough, and gives attachment to muscles. At the back of the cartilage there is a flat and rather square surface, which is marked by a median ridge between two contiguous muscular depressions; and on each side immediately in front of the square surface, is a slight articular mark, which receives the lower cornu of the thyroid cartilage. The inner surface is smooth, and is covered by mucous membrane.

Surfaces.

The lower border is almost straight, and is united to the first ring of the trachea by fibrous membrane. But the upper border is irregular in its outline: it is nearly straight posteriorly, opposite the deep part of the cartilage, and this portion is limited on each side by an articular mark for

Borders, the upper most uneven.

the arytænoid cartilage; but in front of that spot the border is sloped obliquely downwards to the middle line. At the middle line behind there is a slight excavation in each border.

Arytænoid cartilages. The *arytænoid cartilages* are two in number, one on each side of the middle line, and are placed on the upper border of the cricoid cartilage, at the back of the larynx. Each

Situation and form. cartilage is pyramidal in shape, and offers for examination a base and apex, and three surfaces.

Base. The base has a slightly hollowed surface posteriorly for articulation with the cricoid cartilage, and is elongated anteriorly by means of a process which gives attachment to

Apex. the vocal cord. The apex is directed backwards and somewhat inwards, and is surmounted by the cartilage of Santorini.

Three surfaces. The inner surface is narrow, especially above, and flat; but the outer is wide and irregular: on this last surface there is a smaller projection that receives the insertion of some of the muscles. At the posterior aspect the cartilage is concave and smooth.

Two cartilages of Santorini. *Cartilages of Santorini.*—Attached to the apex of each arytænoid cartilage is the small, conical fibro-cartilaginous body of Santorini (corniculum-capitulum Santorini), which is bent inwards towards the one of the opposite side. The arytæno-epiglottidean fold is connected with it.

Two cuneiform cartilages. *Cuneiform cartilages.*— Two other small fibro-cartilaginous bodies, one on each side, which are contained in the arytæno-epiglottidean folds, have received this name. Each is somewhat elongated and circular in form, like a grain of rice; it is situate obliquely in front of the capitulum of the arytænoid cartilage, and its place in the fold of the mucous membrane is marked by a slight whitish projection.

Epiglottis. The *epiglottis* is the largest of the pieces of yellow carti-

Form and position. lage. In form it resembles a leaf, with the stalk below, and the lamina or expanded part above. Its position is behind the tongue, and in front of the orifice of the larynx. During respiration it is placed vertically, but during deglutition it assumes a horizontal direction, so as to close the opening of the larynx.

Surfaces. The anterior surface is bent forwards to the tongue, to which it is connected by three folds of mucous membrane; and the posterior surface is hollowed from side to side, but

convex from above down. To its sides the arytæno-epiglottidean folds of mucous membrane are united. The lower part is connected by a fibrous band (thyro-epiglottidean ligament) to the posterior surface of the thyroid cartilage, near the notch in the upper border. The epiglottis is further connected to the hyoid bone and the root of the tongue, in front of it, by strong bands of elastic and fibrous tissue. After the mucous membrane has been removed from the epiglottis, the fibro-cartilaginous structure will be seen to be perforated by numerous apertures, that lodge muciparous glands. Sides. Foot stalk. Glands in it.

Between the epiglottis and the hyoid bone is a mass of yellowish fat with some glands, which has been sometimes called the epiglottidean gland. Supposed gland.

Ligaments of the Larynx.—The larynx is connected by ligaments with the hyoid bone above, and with the trachea below. Besides, there are connecting fibres uniting together the cartilages; and between some of the cartilages synovial membranes exist. Ligaments of the larynx,

Union of the larynx with the hyoid bone and the trachea.—A thin loose elastic membrane (thyro-hyoid) passes from the thyroid cartilage to the hyoid bone, and a second membrane connects the cricoid cartilage with the trachea. between os hyoides and trachea.

The *thyro-hyoid ligament* is attached on the one part to the upper border of the thyroid cartilage, and on the other, to the upper border of the hyoid bone, at the posterior aspect. Of some thickness in the centre, it gradually becomes thinner towards the sides, and finally ends in a rounded elastic cord that intervenes between the extremity of the hyoid bone and the upper cornu of the thyroid cartilage. The superior laryngeal nerve and artery perforate this ligament, and a synovial membrane is placed between it and the posterior surface of the hyoid bone. In the elastic lateral part of the ligament will be sometimes found a small ossific nodule (cartilago triticea). Thyro-hyoid membrane.

The membrane joining the lower border of the cricoid cartilage to the first ring of the trachea—*crico-tracheal ligament*, resembles the band joining the rings of the trachea to each other. Crico-tracheal membrane.

Union of the cricoid and thyroid cartilages.—These cartilages are joined, in the middle line in front, by the crico- Between cricoid and thy-

roid cartilages are thyroid ligament; and on the side, by a capsular ligament around the small cornu of the thyroid cartilage.

an anterior ligament The *anterior crico-thyroid ligament* or membrane is yellow in colour, and is formed mostly of elastic tissue. At its centre it is thick and strong, and is attached to the contiguous margins of the cartilages from which it is named; but on the sides the ligament is thin, and leaving the lower border of the thyroid cartilage is continued upwards into the chorda vocalis. Some small apertures exist in this membrane for the passage of small arteries into the larynx. The ligament is partly concealed by the crico-thyroid muscle.

and a lateral joint. The *lateral crico-thyroid*, or *capsular ligament*, surrounds the articular surfaces between the side of the cricoid and the lower cornu of the thyroid cartilage. Its fibres are strongest behind. A *synovial membrane* lines the capsule.

Between cricoid and arytænoid *Articulation between the cricoid and arytænoid cartilages.* — This articulation allows of most movement, and the surfaces of the cartilages, which are in contact, are retained by a capsule, and possess a synovial sac.

is a capsule and sac. The *capsular ligament* is fixed to each cartilage around its articular surface; and one part — *posterior* ligament, is strongest on the inner and posterior aspects. A loose *synovial membrane* is present in the articulation.

Between arytænoid and capitulum. A kind of *capsule*, with a *synovial sac*, unites the apex of the arytænoid cartilage with the hollowed base of the capitulum of Santorini. Sometimes these cartilages are blended together.

Between thyroid and arytænoid. The *ligaments* joining the *thyroid* with the *arytænoid cartilages* (thyro-arytænoid) have been already examined as the vocal cords in the interior of the larynx (p. 169.).

Two ligaments of epiglottis. *Ligaments of the epiglottis.* — A band — *thyro-epiglottidean*, connects the lower part of the epiglottis to the posterior surface of the thyroid cartilage, close to the excavation in the upper border of the latter. Some fibrous and elastic tissue — *hyo-epiglottidean ligament*, likewise connects the front of the epiglottis to the hyoid bone.

Constituents of trachea. STRUCTURE OF THE TRACHEA. — The air tube consists chiefly of a series of pieces of cartilage (segments of rings), which are connected together by fibrous tissue. The in-

terval between the cartilages at the back of the tube is closed by fibrous membrane, and by muscular fibres and muciparous glands; and the trachea is lined by mucous membrane with subjacent elastic tissue.

Cartilages.— The pieces of cartilage vary in number from sixteen to twenty. Each forms an incomplete ring, which occupies about three fourths of a circle; and each is convex forwards, forming the front and sides of the air tube. At the extremities of the trachea, both above and below, these cartilaginous pieces are least constant in size and form; for towards the larynx they increase in depth, whilst the lowest piece of cartilage is shaped like the letter V: at the extremes also of the tube, the cartilages may be slit at their ends, or may be blended together. A fibrous tissue is continued from one to another on both aspects, though in greatest quantity externally, so as to incase and unite them, and is extended across the posterior part of the air tube.

Cartilages. Form. Peculiarities; are contained in fibrous tissue.

Dissection. — On removing the fibrous membrane and the muciparous glands from between the cartilages at the back of the trachea, the muscular fibres will appear. After the muscular fibres have been examined, they may be cut through to see the elastic tissue and the mucous membrane.

Dissection.

Muscular fibres.— Between the ends of the cartilages is a continuous layer of transverse unstriated fibres, which are attached to the truncated ends and the inner surface of the cartilages. By the one surface the fibres are in contact with the fibrous membrane and the glands, and by the other with the next structure. Some longitudinal fibres are superficial to the transverse (Kramer)*; they are arranged in scattered bundles, and are attached to the fibrous tissue.

Muscular fibres close trachea behind.

The *elastic tissue* forms a complete lining beneath the mucous membrane to the tracheal tube; though at the posterior part, where the cartilages are deficient, it is gathered into strong longitudinal folds. This layer is closely connected with the mucous membrane covering it.

Elastic tissue lines trachea.

The *mucous membrane* of the trachea lines the tube, and resembles that of the larynx, with which it is continuous, in being furnished with a columnar ciliated epithelium. Connected with this membrane are numerous muciparous com-

Mucous membrane, epithelium, and glands.

* See *Kölliker's Anatomie*, p. 305. (Zweiter Band).

pound *glands* of variable size. The largest set are found at the back of the trachea, in the interval between the cartilages, where some are placed beneath the mucous membrane with the muscular fibres, and others outside the fibrous tissue: the ducts of the last pass forwards between the muscular fibres to the surface of the mucous membrane. Other smaller glands occupy the front and sides of the trachea, being situate on and in the fibrous tissue connecting the cartilaginous rings.

SECTION XVIII.

PREVERTEBRAL MUSCLES AND VERTEBRAL VESSELS.

Deep muscles of spine. *Directions.*—On the part of the spinal column that was laid aside after the separation of the pharynx from it, the student is to dissect the deep muscles on the front of the vertebræ.

Dissection. *Dissection.*—To dissect those muscles, it will be necessary to remove the connective tissue. The muscles are three in number on each side, and are easily distinguished. The largest one, nearest the middle line, is the longus colli; the muscle external to this, which reaches to the head, is the rectus capitis anticus major; and the small muscle, external to the last and close to the skull, the rectus capitis anticus minor. The smaller rectus muscle is usually injured in cutting through the basilar process of the occipital bone.

Longus colli. The LONGUS COLLI MUSCLE is situate on the bodies of the cervical and upper dorsal vertebræ, and is pointed above, Origin but larger below. It consists of two parts—internal and external, the former being vertical, and the latter oblique by two pieces. in direction. The internal part *arises* by fleshy and tendinous processes from the bodies of the two upper dorsal, and two lower cervical vertebræ; and the external piece takes origin from the upper border of the transverse processes (parapophyses) of four cervical vertebræ (sixth, fifth, fourth, and third). Both parts of the muscle are blended above, Insertion. and the whole is *inserted* by four slips into the lower border of the bodies of the four upper cervical vertebræ. Some of the lowest fibres of the muscle, those which sometimes extend out as far as the head of the first rib, are attached separately by tendon to the transverse processes of one or

two of the lower cervical vertebræ. In contact with the anterior surface of this muscle is the pharynx. The inner border is at some distance, inferiorly, from the muscle of the opposite side, but, superiorly, only the pointed anterior common ligament of the spine separates the two. The outer border is contiguous to the scalenus, to the vertebral vessels, and to the rectus capitis anticus major muscle. Parts in contact with it.

The RECTUS CAPITIS ANTICUS MAJOR is external to the preceding muscle, and is largest at its upper end. Its *origin* is by pointed tendinous slips from the summits of the transverse processes (parapophyses) of four cervical vertebræ (sixth, fifth, fourth, and third); and the fibres ascend to be *inserted* into the basilar process of the occipital bone, in front of the foramen magnum. The anterior surface of the muscle is covered by the pharynx, and by the carotid artery and the numerous nerves near the base of the skull. This muscle partly conceals the following one. At its insertion the rectus is fleshy, and reaches from the middle line to the temporal bone. Rectus capitis major. Origin. Insertion. Connections.

The RECTUS CAPITIS ANTICUS MINOR is a small flat muscle, that *arises* from the transverse process (parapophysis), and partly from the body of the atlas ; and ascending is *inserted* into the basilar process of the occipital bone, between the foramen magnum and the preceding muscle, and half an inch from its fellow. The anterior primary branch of the suboccipital nerve lies between the borders of this muscle and the rectus capitis lateralis. Rectus capitis minor is beneath preceding.

Dissection.—The small intertransversales will come into view when the other muscles have been removed from the front and back of the transverse processes. By tracing towards the spine the anterior primary branch of one of the cervical nerves, the muscles will be readily found, for they are placed on the sides of the nerve. After the muscles and nerves have been examined, the tips of the transverse processes may be cut off to lay bare the vertebral artery. Dissection.

The INTERTRANSVERSE MUSCLES are slender fleshy slips that occupy the intervals between the transverse processes. In the neck there are seven pairs—one for each space. The first pair is between the atlas and the axis, whilst the last is between the last cervical, and the first dorsal vertebra. One set is attached to the anterior, and the other to the Intertransverse muscles. Number and attachments.

posterior tubercles on the tips of the conjoined transverse processes (diapophyses and parapophyses). Between the muscles, except in the first two spaces, is the anterior primary branch of a cervical nerve; and beneath the posterior muscle is the other primary branch of the same nerve.

Peculiarities. In the upper intertransverse space the posterior muscle is often wanting; and, in the lowest space, the muscle of the anterior set is smaller than the others, or it may be absent.

Cervical nerves in their foramina give *Cervical nerves at their exit from the spinal canal.*—The cervical nerves issue from the spinal canal through the intervertebral foramina, with two exceptions, and bifurcate into an anterior and a posterior trunk.

anterior The *anterior primary branch* passes outwards between the intertransverse muscles, and joins in plexuses in the neck (p. 76.).

and posterior trunks. The *posterior primary branch* turns to the back beneath the posterior intertransverse muscle, and the other muscles attached to the posterior transverse processes (diapophyses); it lies close to the bone between the articular processes of the vertebra.

First two nerves differ *Peculiarities in the first two.*— The first two nerves leave the spinal canal above the neural arches of the first two vertebræ, and divide at the back of the neck into anterior and posterior trunks.

in both anterior and The anterior primary branch of the first or suboccipital nerve has been examined (p. 120.). The anterior branch of the second nerve, after perforating the membrane between the neural arches of the first and second vertebræ, is directed forwards outside the vertebral artery, and beneath the intertransverse muscle of the first space, to join the cervical plexus.

posterior trunks. The posterior primary branches of the first two nerves are described in the dissection of the back.

Vertebral artery in the foramina of cervical vertebræ. The *vertebral artery* has been seen at its origin in the neck (p. 73.); and its termination will be described with the vessels of the brain. Entering the foramen between the transverse processes of the sixth cervical vertebra (usually), the artery ascends vertically through the corresponding foramina of the other vertebræ; and having passed through the aperture of the atlas, the vessel turns backwards on the neural arch of that bone, and enters the skull through the

foramen magnum, after passing beneath the ligament joining the atlas and the occipital bone. In its course through the foramina, the artery lies in front of the anterior trunks of the cervical nerves, except those of the first and second,— the former of which crosses on its inner, and the latter on its outer side. The vessel is accompanied by a vein, and a plexus of nerves of the same name. In its course the artery furnishes small twigs to the surrounding muscles, and to the spinal canal and the contained cord.

Position to the nerves.

A vein and nerves are with it.

The *vertebral vein* commences by small radicles in the occiput, and in the muscles of the back of the neck, and enters the aperture of the atlas, where it sometimes receives a vein through the posterior condyloid foramen of the occipital bone. Accompanying the artery, the vein traverses the apertures between the transverse processes, and ends in the subclavian vein. In its course it receives branches from the internal and external spinal veins; its other branches are described at p. 74.

Vertebral vein

ends in subclavian.

Branches.

The *vertebral plexus of nerves* is derived from the inferior cervical ganglion of the sympathetic. The plexus surrounds the artery, and communicates with the spinal nerves as high as the third or fourth.

Plexus of nerves.

Section XIX.

LIGAMENTS OF THE VERTEBRÆ AND CLAVICLE.

Directions.— On the remaining part of the spine, the ligaments that connect the cervical vertebræ one to another and to the occipital bone are to be examined.

Directions.

Dissection. — Separate the cervical from the dorsal vertebræ by disarticulation. Then remove altogether the muscles, vessels, nerves, and loose connective tissue and fat from the vertebræ. By sawing through the occipital bone, so as to leave only an osseous ring bounding posteriorly the foramen magnum, the ligaments between the atlas and the occipital bone can be more easily cleaned.

Dissection.

The COMMON LIGAMENTS attaching together the cervical vertebræ are similar to those uniting the vertebræ in other parts of the spine, viz. an anterior and a posterior strong ligament; bands between the laminæ and spines; capsular

Common ligaments of a vertebra.

ligaments and synovial membranes for the articulating processes; and an interarticular ligament between the bodies of the bones.

These ligaments described elsewhere.

Directions.—These ligaments are first to be learnt: their preparation and description will be found with the dissection of the ligaments of the spine, at the end of the thorax. But in opening the spinal canal, to see the ligaments inside it, the arches of the three highest vertebræ should for the present be left untouched.

Special ligaments

SPECIAL LIGAMENTS unite the first two cervical vertebræ to each other and to the occipital bone: some of these are external to, and others within the spinal canal.

between first two vertebræ and occipital bone,

The *ligaments outside the spinal canal* are thin fibrous membranes, that connect the bodies and arches of the first two vertebræ in front and behind, and join the atlas with the occipital bone at the same aspects. Capsular ligaments surround the articular surfaces of all the bones, but these will be examined more conveniently after the spinal canal has been opened.

posterior and

a. Union of the atlas with the axis.—1. The *posterior ligament* (atlo-axoid) is a thin loose membrane, which is attached by the one margin to the neural arch of the atlas, and by the other to the corresponding arch of the axis. Below the superficial layer are some deeper and stronger fibres. The second nerve pierces it. 2. The *anterior ligament* unites the bodies of the first two vertebræ in the same manner as the preceding ligament connects their arches. It is thickest in the middle.

anterior atlo-axoid;

b. Union of the atlas with the occipital bone. — 1. The *anterior ligament* (occipito-atloid) is thin and wide, and passes from the basilar process of the occipital bone, in front of the foramen magnum, to the body of the atlas. The middle part of the ligament, which is fixed to the tubercle on the front of the atlas, is much the thickest. 2. The *posterior ligament* is fixed to the occipital bone behind the foramen magnum, and to the neural arch of the atlas. It is thin; and at its attachment to the bone below, the vertebral artery and the posterior primary branch of the suboccipital nerve pass beneath it.

and anterior and posterior occipito-atloid.

Ligaments internally

The *ligaments inside the spinal canal* are peculiar in form, and assist to retain the skull in position during the

rotatory and nodding movements of the head. Between the occipital bone and the second vertebra are three strong ligaments — a central one, and two lateral or check ligaments; and, moreover, the odontoid process of the axis is fixed against the body of the atlas by a strong transverse ligament. between same bones.

Dissection.— Supposing the arches of the cervical vertebræ to be removed, except from the first three, the arches of these vertebræ are to be sawn through internal to their articular processes. Afterwards the ring of the occipital bone bounding posteriorly the foramen magnum is to be taken away. Lastly, the student should detach the tube of dura mater from the interior of the spinal canal; and on raising, from below, the upper part of the posterior common ligament of the bodies of the vertebræ. the central ligamentous band between the occipital bone and the axis (occipito-axoid) will come into view. Dissection.

a. Union of the occipital bone with the axis — 1. The *central ligament* (occipito-axoidean) is a strong thick band, which is connected with the posterior ligament of the bodies of the vertebræ, and is rather pyramidal in form, with the base uppermost. Above it is attached to the basilar process on the cranial aspect, and near the margin of the foramen magnum, extending as far on each side as the insertion of the check ligaments. From this spot it descends over the odontoid process, and, becoming narrower, is inserted into the body of the axis. Occasionally a bursa is found between the transverse ligament of the atlas and the superficial fibres of this occipito-axoidean ligament which are continued to the second vertebra. Between skull and axis is a thick central band.

Dissection. — After the removal of the occipito-axoidean ligament, the following check ligaments will be partly seen, together with the transverse ligament. A band of fibres is to be defined, that passes upwards and downwards from the transverse ligament; but the upper offset may be cut through for the purpose of seeing the check ligaments. Dissection.

2. The lateral *odontoid* or *check ligaments* are two strong bundles of fibres, one on each side: each is attached by one end to the rough side of the head of the odontoid process, and by the other to a depression on the inner surface of the condyle of the occipital bone. These ligaments are covered by the occipito-axoidean band, and diverge from the centre And two lateral or check ligaments.

to the sides of the spine; their upper fibres are short and almost horizontal, and the lower are longer and oblique.

With a central band.

Between the lateral bands there is a central *odontoid ligament*, that connects the tip of the odontoid process to the margin of the basilar process of the occipital bone.

To fix odontoid process there is a transverse ligament,

b. Union of the atlas with the axis.—The *transverse ligament* of the atlas is a flat, strong, arched band behind the odontoid process, which is attached on each side to a tubercle below the inner part of the articular process of the atlas. This ligament is widest in the centre, and at this spot it has a band of longitudinal fibres connected with its upper and lower margins, so as to produce a cruciform appearance: of these bands, the upper one is inserted into the basilar process, and the lower one into the body of the second vertebra. Its surface towards the cord is concealed by the occipito-axoid ligament. This ligament fixes firmly the odontoid process of the second vertebra against the body of the atlas, confining it in a ring.

articular surfaces, and two synovial membranes.

When the transverse and check ligaments have been cut through, the tip of the odontoid process will be seen to have two cartilaginous surfaces; one in front where it touches the atlas, the other at the opposite aspect, where it is in contact with the transverse ligament. Two *synovial membranes* facilitate the movements of the odontoid process, one being for the joint between the piece of bone and the atlas, and the other for that between it and the transverse ligament.

Capsule and synovial sac to articular surfaces.

Union of the articular surfaces. — *a.* The articular surfaces of the occipital bone and atlas are surrounded by a capsular ligament of scattered fibres, which is strongest externally and in front. When the joint is opened, the condyle of the occipital bone will be seen to look somewhat outwards, whilst the hollowed surface of the atlas has an opposite direction. A *synovial membrane* is present on each side. *b.* The articular surfaces of the first two vertebræ are enclosed on each side by a capsule, which is stronger in front than behind. On opening the joint, the surfaces of the bones may be perceived to be almost horizontal. On each side there is a separate loose *synovial membrane.*

Joint at sternal end of clavicle.

Sterno-clavicular Articulation. — The internal end of the clavicle is received on a fibro-cartilage, and is retained in position by a capsular ligament, by a band to the

first rib, and by another between the ends of the two clavicles.

Dissection.—For the examination of the ligaments in the sterno-clavicular articulation, take the piece of the sternum that was laid aside for that purpose; and should the ligaments have become dry, they ought first to be moistened for a short time. The several ligaments will appear after the removal of some connective and fibrous tissues. Dissection.

Capsular ligament.—This is a thin membranous expansion, that incases the articular ends of the bones, and the fibro-cartilage. It is attached near the articular surface of each bone, and is thinner before than behind. Sometimes the stronger fibres, that exist in front and at the back, are described as separate ligaments. Capsular ligament.

The *interclavicular ligament* extends above the sternum, between the ends of the clavicles. The fibres do not cross in a straight line, but dip into the hollow between the clavicular bones, and are connected with the upper part of the sternum. Inter-clavicular,

The *costo-clavicular ligament* is a short strong band of oblique fibres between the first rib and the clavicle. Inferiorly it is fixed to the upper surface of the cartilage of the first rib, and superiorly to a tubercle on the under surface of the clavicle near the sternal end. The subclavius muscle is in front of the ligament. Sometimes the clavicle touches the rib, and is provided with an articular surface and a synovial membrane at that spot. and costo-clavicular ligament.

The *interarticular fibro-cartilage* will come into view by cutting the ligaments before described, and raising the clavicle. It is flat, and almost circular in form, but is thicker at the circumference than the centre. By its upper surface and margin the cartilage is united to the head of the clavicle which is imbedded in it; and by the opposite surface and margin it is connected with the cartilage of the first rib. At its circumference it joins the capsule of the joint. Sometimes there is an aperture in the centre of the cartilage. Fibro-cartilage.

Two *synovial membranes* are present in the articulation, one being on each side of the fibro-cartilage. The sac in contact with the sternum is looser than that touching the clavicle. Two synovial membranes.

CHAPTER II.

DISSECTION OF THE BRAIN.

Section I.

MEMBRANES AND VESSELS.

Position of the brain. During the examination of the membranes, the vessels, and the nerves, the brain is to be placed upside down, resting in the coil of a cloth which supports it evenly.

Three meninges. Membranes of the Brain.—The coverings of the brain (meninges) are three in number, viz. dura mater, pia mater, and arachnoid membrane. The dura mater is a firm, fibrous investment that supports parts of the brain, and serves as an endosteum to the bones. The pia mater is the most internal layer, and is very vascular. And the arachnoid is a thin serous sac, which is situate between the other two.

Besides enveloping the brain, these membranes are prolonged on the cord into the spinal canal, and will be noticed in the dissection of that part. The description of the dura mater will be found at p. 10.

Dura mater.

Arachnoid membrane. The arachnoid is a thin serous membrane, which lines the inner surface of the dura mater *, and is reflected over the pia mater and the brain. Around the vessels and nerves that intervene between the skull and the brain, the membrane forms sheaths, which extend a short distance into the several apertures, and then become continuous with the parietal or cranial portion. Like other serous membranes, it forms a sac which contains a lubricating moisture ; and it consists of a parietal and a visceral part.

Parietal part. The *parietal* part is inseparably united to the inner surface of the dura mater, giving to it a smooth and polished surface, and is continued in the same manner over the pieces of that membrane that project between the different portions of the brain.

* The existence of a distinct parietal part to this membrane is denied by Professor Kölliker, *Mikroskopische Anatomie*, p. 489. (Zweiter Band).

The *visceral* part covers the encephalon loosely, especially at the under surface, and beneath it there is a considerable interval (subarachnoid space). When it is traced over the brain, the following is the disposition of the serous membrane. On the upper or convex surface of the cerebrum the membrane passes from one convolution to another, without dipping into the intervening hollows; though it lines the great median fissure as low as the extent of the falx. On the lower or under surface of the cerebral mass the arachnoid covers the anterior lobes, and sinks also into the median fissure: but farther back there is a space between it and the brain. Still more posteriorly the serous membrane is closely connected to the pons and the under surface of the cerebellum; but between the hemispheres of the little brain there is another space beneath it, similar to that at the under part of the cerebrum.

Visceral part is not close to brain, hollow beneath, varies at spots;

The *subarachnoid space*, or the interval between the arachnoid membrane and the pia mater, is larger in one spot than another, and contains more or less fluid, that has been named cerebro-spinal. This space is largest at the under part of the great brain about its middle, and in the fissure between the hemispheres both of the cerebrum and the cerebellum. If the arachnoid covering is removed from the fissure between the halves of the cerebellum, the aperture of the fourth ventricle will be perceived, by which the cavity in the interior of the brain communicates with the subserous space both of the encephalon and of the spinal cord.

it is the sub-arachnoid space.

The PIA MATER, or the vascular covering of the brain, closely invests the different parts of the cranial mass, and dips into the fissures, as well as into the hollows between the surface convolutions and laminæ. Besides covering the exterior of the brain, it sends processes into the interior to supply vessels to the walls of the enclosed spaces: thus, one penetrates into the cerebrum below the corpus callosum, and is named velum interpositum; and two vascular fringes project into the fourth ventricle, and are known as the choroid plexuses of that cavity.

Pia mater sends pieces into the brain;

This membrane is a net-work of vessels, and is constructed of the minute ramifications of the arteries entering the substance of the brain, and of the veins issuing from the cerebral substance; whilst the intervals between the vessels

it is a net-work of blood-vessels.

are closed by connective tissue, so as to form a continuous membrane. From the under surface of the pia mater proceed numerous fine vessels for the nutrition of the brain.

Vessels and nerves. *Vessels and nerves.* — The arachnoid membrane has but few vessels, whilst the pia mater is almost entirely composed of vessels and nerves. The arachnoid is considered to be nerveless; but the pia mater is largely supplied by offsets of the sympathetic, that accompany the bloodvessels at the base of the brain (p. 22.). Bochdalek has also described offsets to it from some cranial nerves.

Dissection of the vessels. *Dissection.*— To follow out the arteries, let the brain remain upside down, and let the arachnoid membrane be removed from the vessels that are seen on the surface. First, the two arteries that lie in the median fissure of the great brain may be defined; next, the artery that passes outwards transversely between the two lobes of that brain; and, lastly, a vessel that bends backwards along the inner part of the great brain (cerebrum). One artery may be seen ramifying on the upper (in the present position) surface of the little brain, and another is to be followed to the opposite surface.

Subdivisions of the encephalon.— Before entering into the detail of the anatomy of the arteries, the chief subdivisions of the encephalon may be shortly mentioned.

Outline of cranial mass. The cranial or encephalic mass of the nervous system consists of cerebrum or great brain, cerebellum or small brain, and pons and medulla oblongata. Each of these parts has the following situation and subdivisions: —

Upper part of spinal cord. The medulla oblongata, or the upper end of the spinal cord, lies in the groove between the halves of the small brain, and is divided into two symmetrical parts by a median fissure. To each half some of the cranial nerves are united.

Pons Varolii The pons Varolii is situate in front of the medulla oblongata, and is marked along the middle by a groove, which indicates its separation into two halves. In front of it are two large processes (crura cerebri) that pass to the great brain; on each side it is united to the small brain by a similar white mass (crus cerebelli); and behind it is the enlarged upper part of the cord.

and its crura.

Cerebellum. The cerebellum, or the small brain, is divided into two

halves by a median fissure, and each half will be subsequently seen to be subdivided into lobes.

The cerebrum, or the large brain, is also divided into two halves by a longitudinal fissure in the middle line. Each half is further subdivided into anterior, middle, and posterior lobes. Between the anterior and the middle lobe is a sulcus, — the fissure of Sylvius; but the limit between the middle and the posterior is indicated by a line corresponding to the anterior part of the small brain. In the centre of the cerebrum, between the hemispheres and in front of the pons, are several small bodies that will be afterwards enumerated. Cerebrum and its great divisions.

Arteries of the Brain. — The brain is supplied with blood by the two vertebral, and the two internal carotid arteries. Arteries of the brain.

The *vertebral artery* is a branch of the subclavian trunk, and enters the spinal canal beneath the membrane between the atlas and the occipital bone. Ascending then to the brain round the side of the medulla oblongata, the artery enters the skull through the foramen magnum, and is blended with its fellow in one trunk (basilar) at the lower border of the pons. As the vessel winds round the upper part of the cord, it lies between the roots of the hypoglossal and sub-occipital nerves; but it is afterwards internal to the former. Vertebral ends in basilar, winds round medulla.

Branches. — Between its entrance into the spinal canal and its termination, each artery furnishes offsets to the spinal cord, to the dura mater, and to the cerebellum. Branches

a. The *posterior spinal branch* is of inconsiderable size, and arises opposite the posterior part of the medulla: it descends along the side of the cord, behind the nerves, anastomosing with its fellow, and with branches that enter by the intervertebral foramina. to spinal cord, anterior and

b. The *anterior spinal branch* is as small as the preceding, and springs from the artery opposite the front of the spinal cord. This small branch joins the corresponding twig of the opposite side, and the resulting vessel is continued along the middle of the cord on its anterior aspect. posterior;

c. The *posterior meningeal artery* leaves the vertebral trunk opposite the foramen magnum, and ramifies in the dura mater lining the fossæ of the occipital bone. of dura mater.

Branch to the under part of cerebellum.

d. The *inferior cerebellar artery* (posterior) is distributed to the under surface of the cerebellum. Taking origin from the end of the vertebral, or from the basilar artery, this branch winds backwards round the side of the medulla, between the pneumo-gastric and spinal accessory nerves, and enters the median fissure of the cerebellum. Directed onwards along the fissure, the artery reaches the upper surface of the small brain, and there anastomoses with the superior cerebellar artery. A branch of this vessel ramifies over the under surface of the cerebellum, and ends externally by anastomosing with the upper cerebellar artery. As the vessel lies by the side of the aperture of the fourth ventricle, it gives a small offset to the choroid plexus of that cavity.

Basilar artery. Extent and situation.

The *basilar artery* is the vessel resulting from the union of the two vertebral arteries. It reaches from the lower to the upper border of the pons, and ends at the last spot by dividing into two branches (posterior cerebral) for the cerebrum. The vessel touches the basilar process of the occipital bone, from that circumstance receiving its name, and corresponds to the median groove of the pons. On each side of, and almost parallel to it is the sixth nerve.

Branches:

Branches. — Besides the terminal branches, one to each side, mentioned above, the artery supplies transverse offsets to the pons and the under part of the cerebellum, and a large branch to the upper surface of the cerebellum.

transverse to the pons,

a. The *transverse arteries* of the pons are four or six small twigs, that are named from their direction, and are distributed to the substance of the pons. One of these gives an offset to the internal auditory meatus along the seventh nerve. Resembling most this set of branches is the following artery, the *inferior cerebellar* (anterior): this arises from the basilar trunk, and is directed outwards to the under surface of the cerebellum, at the anterior part, on which it is distributed.

and inferior cerebellar.

Superior cerebellar.

b. The *superior cerebellar artery* is derived from the basilar so near its termination that it is often described as one of the final branches of that vessel. Its destination is the upper aspect of the cerebellum, to which is is directed backwards over the third nerve and the crus cerebri, but parallel with the fourth nerve. On the upper surface of the cerebellum the artery spreads out in branches, and its rami-

fications anastomose with the vessel of the opposite side, and with the inferior cerebellar artery. Some twigs of this vessel enter the piece of the pia mater (velum interpositum), that projects into the posterior part of the cerebrum.

c. The *posterior cerebral artery* takes on each side a backward course, similar to that of the preceding artery, but separated from it by the third nerve. The vessel is then inclined to the posterior lobe of the cerebrum, at the inner side, and divides into many branches. Some of these supply the under part of the posterior lobe, whilst others turn upwards on both the outer and inner aspects of the back of the hemisphere, and anastomose with the other cerebral arteries. Its branches are the following: — Posterior cerebral artery;

Numerous small long branches leave it close to its origin, and enter the base of the brain between the crura cerebri (posterior perforated spot). Soon afterwards the vessel is joined by a small straight branch (posterior communicating) from the internal carotid artery. Lastly, it furnishes a small *choroid* artery to the fold of pia mater that projects into the cerebrum: this small branch winds round the crus cerebri, and is transmitted between the crus and the hemisphere of the cerebrum to the velum interpositum and the choroid plexus. its offsets are commu-nicating and cho-roid.

From the foregoing examination of the offsets of the vertebral arteries, and of the trunk (basilar) that continues them onwards, it appears that about half the encephalon — viz. the medulla oblongata, the pons, the cerebellum, and the posterior third of the cerebrum—receives its blood through the branches of the subclavian arteries. Part of brain supplied by ver-tebral arteries.

The INTERNAL CAROTID ARTERY terminates in the great brain by supplying branches to the remaining two thirds, or to the anterior and middle lobes. Having passed through the space of the cavernous sinus (p. 22.), the vessel emerges on the inner side of the anterior clinoid process, and divides at the inner end of the fissure of Sylvius into anterior cerebral, middle cerebral, and posterior communicating arteries. At the base of the brain the carotid artery lies between the second and third nerves, but nearest the former. Internal carotid ends in cerebral arteries.

Branches. — In the skull the carotid artery supplies the ophthalmic offset, before it ceases in the following terminal branches to the cerebrum. Branch-es.

Anterior cerebral supplies inner part of hemisphere; communicating artery;

1. The *anterior cerebral artery* supplies the inner part of the cerebral hemisphere. The vessel of each side is directed forwards to the median fissure between the halves of the large brain; and as the two are about to enter it, they are united by a short thick artery, the *anterior communicating.* Each artery then runs forwards in the fissure, and bends round the anterior part of the corpus callosum, so as to be placed on the upper aspect in the natural position of the brain. Still continuing backwards nearly to the posterior extremity of the hemisphere, the vessel gives off numerous branches, which anastomose with the other cerebral arteries. It supplies other branches, thus:—

its offsets.

Near its commencement the artery furnishes many small branches to the part of the brain contiguous to the inner end of the fissure of Sylvius (anterior perforated space); and it distributes some branches to the under part of the anterior lobe.

Middle cerebral artery;

2. The *middle cerebral artery* is the largest offset of the internal carotid, and supplies the outer side of the hemisphere. Passing outwards in the fissure of Sylvius, the artery divides in it into many large branches that issue at the outer end of that groove, and spreading over the external surface of the hemisphere of the cerebrum, inosculate with the other two cerebral arteries at the front, the back, and the upper part of the brain. Only a few fine offsets require notice:

ends in outer part of hemisphere.

Offsets.

A set of small branches arises at the inner end of the fissure of Sylvius, and enters the cerebral substance through the part called substantia perforata antica.

Posterior communicating.

3. The *posterior communicating artery* is a small twig that is directed backwards parallel to, and on the inner side of the third nerve, to join the posterior cerebral artery (of the basilar) near the pons.

Choroid artery.

4. The *choroid artery* (anterior) is small in size, and arises either from the trunk of the carotid, or from the middle cerebral artery. It passes backwards on the outer side of the preceding, and finds its way between the hemisphere and the crus cerebri to the choroid plexus of the lateral ventricle.

Circle of Willis;

Circle of Willis.—This term has been applied to the chain of communications between the arteries at the base of the brain; for the vessels of the brain are united freely both on

their own side and across the middle line, and give rise to an arterial circle. On each side this circle is formed by the trunk of the internal carotid giving forwards the anterior cerebral, and backwards the posterior communicating artery. In front it is constructed by the converging anterior cerebral, and the anterior communicating artery; and behind, by the bifurcation of the basilar trunk into the two posterior cerebral arteries. In the area of the circle lie the several parts of the brain that correspond to the floor of the third ventricle. The complete inosculation between the cranial vessels, in the circle of Willis, allows at all times a free circulation of blood through the brain, even though a large vessel on one side should be obstructed. vessels that take a share in it, and the free inosculation between them.

The VEINS of the brain enter the sinuses of the dura mater, instead of uniting into trunks that are companions to the arteries. Veins of the brain.

Dissection.—The pia mater and the vessels are now to be stripped from the brain, and the origin of the cranial nerves to be defined. Over the greater part of the cerebrum, the pons, and the medulla, the pia mater can be detached with tolerable facility by using two pairs of forceps; but over the cerebellum the membrane adheres so closely that it will require some care to remove it without tearing the substance of the brain. In clearing out the fissure between the halves of the cerebellum on the under surface, the membrane that bounds on each side the opening of the fourth ventricle will probably be taken away. The student should therefore observe now the position and size of that opening between the back of the medulla oblongata and the inferior vermiform process. When the surface has been cleaned, the brain is to be replaced in the spirit till it is hardened. Dissection. Care to be taken in removing pia mater.

SECTION II.

ORIGIN OF THE CRANIAL NERVES.

The cranial nerves take origin from the encephalon, with one exception (spinal accessory), and pass from it through apertures in the skull. Origin

The origin of a nerve is not determined by the place at which it appears on the surface of the brain, for fibres or is apparent and real.

roots may be traced deeply into the nervous substance. Each nerve has therefore a superficial or apparent, and a deep or real origin in the encephalon.

Real enters gray matter.

Respecting the superficial attachment to the brain there cannot be any doubt; but respecting the deep origin there is much difference of opinion, in consequence of the difficulties attending any inquiry into this subject. When the roots are followed into the encephalon, they are found to be connected with masses of gray substance, which Stilling has named, in many instances, nerve nuclei.*

Classification as nine or twelve pairs.

The cranial nerves may be regarded either as nine or twelve pairs, according to the mode of classifying them. Those anatomists, who follow Willis and take the smaller number, include in one nerve all the trunks contained in the same aperture of the skull: as in the case of the eighth nerve, which consists of three trunks in the foramen jugulare. But those who are disposed with Sömmerring to enumerate twelve nerves, consider each of the three trunks of the eighth nerve before mentioned, and all other trunks issuing from the encephalon in the like way, to constitute a separate cranial nerve, notwithstanding that it may be combined with others in its foramen of exit.

Designation from number, name of part, or function.

The nomenclature of the several nerves is three-fold: Thus, the designation may be numerical, as first, second, third, and so forth: this mode of naming applies to all and is the one generally used. But a second name has been given to a few nerves from the parts to which they are supplied; as instances of this the terms hypoglossal, pneumo-gastric, may be taken. And a different appellation is given to others, in consequence of the function conferred on the part to which they are distributed, as the terms auditory and olfactory express. In this way two names may be employed, almost indifferently, in referring to a nerve: — one being numerical, the other local or functional, as is exemplified below.

Olfactory nerve

The FIRST OR OLFACTORY NERVE (olfactory process) is very soft and pulpy, being destitute of a neurilemma; and it may be considered an advanced part of the brain, for it has both gray substance and white fibres in its composition, like the cerebrum.

lies on anterior lobe,

The olfactory process is a flat-looking band, wider at each end than in the middle, which is lodged in a sulcus on the under aspect of the anterior lobe of the cerebrum, and is

* The statements of Stilling concerning the deep origin are here adopted, as his inquiries are the most complete, but many will probably require modification.

kept in position by the reflection of the arachnoid membrane over it. When the so-called nerve is raised from its sulcus, it may be seen to be prismatic in form, the apex of the prism being directed downwards (in this position).

Anteriorly the nervous substance swells into the *olfactory bulb*,—a mass of gray matter, that rests on the ethmoid bone, and distributes nerves to the nose. Posteriorly the olfactory process is connected to the cerebrum by three roots of origin, external, internal, and middle. forms olfactory bulb,

The *external* or *long root* is a slender white band, which passes along the outer part of the anterior perforated space, and across the fissure of Sylvius, and disappears by sinking into the substance of the middle lobe of the cerebrum. has external

The *internal* or *short root* is also white and delicate, and comes from the inner part of the anterior lobe of the cerebrum. internal and

The *middle* or *gray root* is connected with a conical elevation at the posterior part of the sulcus which lodges the nerve. middle root.

Deep origin.—The external root is said to be connected with the corpus striatum and the anterior commissure, and with the white matter covering the end of the hippocampus major. The inner root joins a band of white fibres connected with a convolution (gyrus fornicatus) to be afterwards examined. And the middle root is continuous with the gray matter of the convolutions. Deep origin.

The SECOND OR OPTIC NERVE is the largest of the cranial nerves, except the fifth, and appears as a flat band on the crus cerebri. Anteriorly the nerves of opposite sides are united in a commissure. The part of the nerve posterior to the commissure is named optic *tract;* but the part beyond the commissural union, which is round and firm from being invested by a neurilemmar sheath of dura mater, is called optic *nerve.* The destination of the nerve is to the eyeball. Optic nerve, part called tract, part, nerve.

The *tract* is the flattened part of the nerve, winding round the peduncle of the cerebrum, which is destitute of neurilemma. In front it ends in the commissure, and behind it splits into two parts at its attachment to the brain. As the tract reaches forwards it crosses the crus cerebri, to which it is attached by its outer or anterior edge; and in front of that peduncle it is placed between the substantia perforata antica on the outside, and the tuber cinereum on the inside, but Tract of the nerve.

whether it receives filaments from one or both of those bodies is uncertain.

Its commissure. The *commissure* (chiasma) of the optic nerves is somewhat of a square shape, and lies on the olivary eminence of the sphenoid bone, within the circle of Willis. It is placed in front of the tuber cinereum; and passing beneath it (in this position of the brain) is the thin lamina cinerea. In the commissure there is a partial crossing of the fibres of the nerves after this manner: — the outer fibres of each tract, few in number, are continued straight to the eyeball of the same side; but the greater part of the others decussate, — those of the right nerve being continued to the left, and *vice versâ*, so as to enter the eye of the opposite side. At the front and back of the commissure are some transverse fibres: — the posterior are continued through the optic tracts back to the brain, without entering the eyes; and the anterior are prolonged to the eyeballs, through the part of the nerve in front of the commissure, but have not any connection with the brain.

Situation and structure.

Arrangement of fibres.

Origin from cerebrum. The *origin* of the nerve will be afterwards seen to come from two of the corpora quadrigemina (nates and testis of one side), and from the optic thalamus and the corpora geniculata.

Origin of third nerve is The THIRD NERVE, muscular nerve of the eyeball, is round and firm, and is attached to the inner surface of the cerebral peduncle, near the locus perforatus, and close in front of the pons Varolii.

deep in crus cerebri. *Deep origin.*—The fibres of the nerve pierce the peduncle, passing through the locus niger, and enter a mass of gray substance in the floor of the aqueduct of Sylvius.*

Origin of fourth nerve from cerebellum, The FOURTH OR TROCHLEAR NERVE cannot be followed backwards, at present, to its origin. It is the smallest of the cranial nerves, and springs from the valve of Vieussens over the fourth ventricle. The nerve appears between the cerebrum and the cerebellum, on the side of the crus cerebri, and is then directed forwards to enter an aperture in the tentorium cerebelli, near the posterior clinoid process.

* The origin of this nerve, and of the others as far as the eighth, is taken from the following work of Stilling, *Untersuchungen über den Bau des Hirnknotens.*

Deep origin.—In entering the valve of Vieussens, the nerves of opposite sides cross. Each then divides into two parts: one (anterior) enters a nucleus of gray matter on the side of the aqueduct of Sylvius; the other (posterior), a nucleus (upper trigeminal) near the top of the fourth ventricle, and in front of the prolongation of the gray matter of the locus cæruleus. and Sylvian aqueduct.

The FIFTH OR TRIGEMINAL NERVE is the largest cranial nerve, and consists of two parts, large and small. This nerve resembles a spinal nerve in possessing two roots, ganglionic or sensory, and aganglionic or motor, which are blended beyond the ganglion. Fifth nerve has two roots.

The nerve is attached to the side of the pons Varolii, nearer the upper than the lower border. The small or aganglionic root is highest, and is separated from the other by two or three of the transverse fibres of the pons. Both roots pass outwards, through an aperture in the dura mater, above the petrous part of the temporal bone, and are blended in the peculiar manner stated in p. 20. Origin from pons,

Deep origin.—Both roots penetrate the fibres of the pons, and are connected with nuclei near the floor of the fourth ventricle. near floor of fourth ventricle;

The *large root* divides into two parts near the mass of gray matter called locus cæruleus (p. 240.). One of these bends downwards to the restiform body. The other, which is smaller, arises from the locus cæruleus, and from the gray matter near it (upper trigeminal nucleus) which the lower part of the trochlear nerve enters; also from the gray substance in the floor of the fourth ventricle, near the hypoglossal nucleus; and from a deeper nucleus, *lower trigeminal*, opposite the lower border of the pons, within the fibres continued from the lateral tract of the medulla. beginning of the large root,

The *small root* begins with the fourth nerve in the *upper trigeminal* nucleus, which is in front of the prolongation upwards from the locus cæruleus, and anterior to the floor of the fourth ventricle. and of small.

The SIXTH NERVE, abducent nerve of the eyeball, springs from the pyramidal body, close to the pons, and sometimes from the lower part of the pons. Origin of sixth nerve,

Deep origin.—The fibres of the nerve bend backwards, through the medulla oblongata, to a nucleus in the floor of the fourth ventricle, whose position is on the outer part of the fasciculus teres, and on a level with the anterior fossa. See Anatomy of Fourth Ventricle (p. 241.). from fourth ventricle.

The SEVENTH CRANIAL NERVE (Willis) appears at the Seventh nerve

has two parts. lowest border of the pons, near the restiform body. It consists of two distinct trunks, facial and auditory; the former being the motor nerve of the face, and the latter the special nerve for the organ of hearing.

Origin of the facial. The *facial nerve* (portio dura, seventh nerve, Sömmerring) is firm and round, and smaller than the auditory, internal to which it is placed. It issues from the lateral tract of the medulla, close to the pons, and is connected with the lower border of the pons.

Small accessory piece. The facial nerve receives a small accessory band of fibres that is intermediate between it and the auditory (intermediate portion of Wrisberg); it is then applied to the auditory nerve, and with it enters the internal meatus.

Auditory part. The *auditory nerve* (portio mollis, eighth nerve, Sömmerring) has a surface attachment to the floor of the fourth ventricle, and to the restiform body. The nerve is very soft, for it obtains its neurilemma, and therewith its consistence, only in the meatus auditorius.

Deep origin of facial; *Deep origin.*—The *facial nerve* penetrates to the floor of the fourth ventricle, and arises from the same nucleus as the sixth nerve. *of auditory.* The *auditory nerve* has a superficial connection with the white transverse fibres that issue out of the median groove in the floor of the fourth ventricle; and it is connected deeply with the lower end of the gray mass called locus cæruleus, by means of many fibres that penetrate the upper part of the restiform body, and the lower part of the pons. It is said by some to be joined with the crus cerebelli by a fasciculus of fibres. Stilling notices gray matter in connection with its fibres, as these penetrate the pons Varolii.

Eighth nerve has three parts. The EIGHTH CRANIAL NERVE (Willis) is placed along the side of the medulla oblongata, and consists of three distinct trunks, glosso-pharyngeal, pneumo-gastric, and spinal accessory: the names of the first two indicate their destination, and the last, besides being accessory to the pneumo-gastric, supplies some muscles.

Origin of glosso-pharyngeal, *a.* The *glosso-pharyngeal nerve* (ninth nerve, Sömmerring) is the smallest of the three, and is situate highest. Its apparent origin is by three or more fibrils, which penetrate the lateral tract of the cord close to the facial nerve.

vagus, *b.* The *pneumo-gastric* or *vagus* (tenth nerve, Sömmerring) is connected with the lateral tract of the medulla, below the glosso-pharyngeal nerve, by a series of filaments, which

are collected at first into bundles, but are finally gathered into one flat band.

c. The *spinal accessory nerve* (eleventh nerve, Sömmerring) consists of two parts — accessory to the vagus, and spinal. spinal accessory has two parts,

The *accessory* part is of small size, and arises by fine filaments in a line with the roots of the vagus, as low as the first cervical nerve. Finally this fasciculus throws itself into the pneumo-gastric nerve outside the skull. (See p. 118.) accessory,

The *spinal* part is firm and round, like the third or the sixth nerve, but only a small piece of it can be now seen. It arises by a number of fine filaments from the lateral surface of the spinal cord near the fissure in this position, as low as the sixth cervical nerve. Along the side of the cord it lies between the ligamentum denticulatum and the posterior roots of the spinal nerves, with the upper of which it may be sometimes connected; and it finally enters the skull by the foramen magnum. spinal:

All three of the nerves converge to a spot below the crus cerebelli, where they rest on a small lobe of the cerebellum (flocculus). From that spot they are directed outwards to the foramen jugulare (p. 21.). all converge in the skull.

Deep origin.—The fibrils of the nerves pierce the medulla; and each nerve, except the spinal part of the last, takes origin, according to Stilling *, from a special nucleus at the back of the medulla oblongata, and near the lower angle of the fourth ventricle. The deep origin,

The *nucleus* of the *glosso-pharyngeal* nerve and that of the *vagus* are in a line, one above another, outside the fasciculus teres. See the Anatomy of the Fourth Ventricle, p. 240. of glosso-pharyngeal, of vagus;

The *accessory* part of the spinal accessory enters a nucleus rather below that of the vagus, which corresponds with the posterior horn of the gray substance of the cord. The *spinal* part of the nerve pierces at intervals the lateral column of the cord, and its roots are connected with a gray external projection near the base of the anterior cornu of the gray crescent of the cord. of two parts of spinal accessory.

The NINTH OR HYPOGLOSSAL NERVE of Willis (twelfth nerve, Sömmerring) is placed on the front of the medulla oblongata, and issues by a series of filaments from the sulcus between the pyramidal and olivary bodies, in a line with the anterior roots of the spinal nerves. Ninth nerve.

* Consult his treatise, *Ueber den Bau der Medulla oblongata.*

Origin from medulla. The filaments of origin unite into two bundles, which separately pierce the dura mater, and do not become blended together till they are outside the cranial aperture.

Deep origin from fourth ventricle. *Deep origin.*—The filaments of this nerve are traced to a nucleus in the floor of the fourth ventricle, between the groove of the middle line and the nuclei of the glosso-pharyngeal and vagus nerves, which corresponds with the lower part of the fasciculus teres.

Section III.

MEDULLA OBLONGATA AND PONS VAROLII.

The medulla oblongata and the pons are interposed between the spinal cord and the brain proper. In these bodies the elements of the cord are re-arranged and increased in volume before entering the cerebrum and the cerebellum.

Directions. *Directions.*— On a single brain the student may ascertain nearly all the anatomy of the parts composing the medulla and the pons; but if he can procure one hardened specimen of the medulla and the pons united, and another of a vertical section through those same bodies, his knowledge will be much more perfect.

Position of the part. *Position.*— The brain is to remain in the position in which it was placed during the examination of the nerves and the vessels.

Upper part of spinal cord. Situation The MEDULLA OBLONGATA is the upper dilated part of the spinal cord which is contained in the cranium. Its limit is the lower border of the pons in one direction, and the level of the upper margin of the atlas in the opposite direction. and form. This part of the cord is pyramidal in form, and measures about one inch and a quarter in length, half an inch in thickness, and three quarters of an inch in breadth at its widest part.

Base. The larger part or the base of the medulla joins the pons, the transverse fibres of the latter marking its limit; and the Apex. apex is blended with the cord at the spot before mentioned. Surfaces. The anterior surface is irregularly convex, and is in contact with the hollowed basilar process of the occipital bone. The opposite surface is somewhat excavated superiorly, where it forms the floor of the fourth ventricle, and rests in the fissure between the halves of the cerebellum. On the poste-

rior aspect there are not any cross fibres of the pons, as in front, to mark the extent of the medulla.

The medulla oblongata is divided into halves by a median fissure in front and behind. The fissures are in a line with those along the cord, and their extent is influenced by the cross fibres before alluded to on the surface; for whilst the anterior one ceases at the pons in a dilated part (foramen cæcum), the posterior is prolonged behind the pons, and into the groove in the floor of the fourth ventricle. Division into halves by fissures.

Each half of the medulla is constituted of the three segments of the spinal cord, which are continued into it; and indications of these are still to be seen on the surface, though the names are altered, and the fibres differently arranged. Thus at the middle line in front is the anterior pyramid corresponding with the anterior column; at the middle line behind the restiform body, continuous with the posterior column; and between these are the fibres of the lateral tract, with an oval projecting body (corpus olivare) on their exterior. Components of each half.

a. The *anterior pyramid* is the most internal eminence, and receives its name from its form and position. Situate on the side of the median fissure, it is internal to the olivary body, from which it is separated by a slight groove. Inferiorly the pyramid is continuous with the anterior column of the cord, and internally it is connected with some decussating fibres from the opposite side across the anterior median fissure (decussation of the pyramids). Enlarging as it ascends, this body enters the pons, but, before disappearing beneath the transverse fibres, it is somewhat constricted and rounded. Anterior pyramid is most internal, and is joined internally by fibres.

b. Lateral tract and *olivary body.*— The *lateral tract* (funiculus lateralis), continuous with the part of the cord between the attachment of the roots of the nerves (lateral column), fills the interval between the anterior pyramid and the restiform body; but its width at the surface is not the same throughout. Opposite the lower part of the medulla oblongata, it is equal in size to each of the other constituent bodies before and behind it; but near the pons its width is diminished, so that it occupies on the surface only the hollow between the outer side of the corpus olivare, and the restiform body. Its direction also is not vertical, for it is Lateral tract varies in size: not straight.

inclined backwards above, as if it was pushed out of the straight line by the projecting olivary body.

Olivary body

The *olivary body* (corpus olivare) is the oval projection close to the anterior pyramid. A shallow groove separates it from the pyramid, and a deeper and wider one is between it and the restiform body. This eminence is shorter than the pyramid, and does not reach to the pons: its upper end is most prominent, and arching round the lower end or sometimes over the surface, are some white fibres (fibræ arciformes).

does not reach pons.

Some arched fibres.

Restiform body is the largest piece;

c. Restiform body and *posterior pyramid.*—The *restiform body* (restis, a rope) forms the largest prominence on the half of the medulla oblongata, and cannot be seen satisfactorily except on a distinct preparation. This body is posterior to the lateral tract, and projects laterally, so as to give the greater width to the upper part of the medulla oblongata. The restiform swelling is continuous inferiorly with the posterior column of the spinal cord; and superiorly it appears to be continued into the pons, like the other segments of the medulla oblongata, but the disposition of its fibres at this spot will be subsequently referred to. Below the level of the olivary body it is divided into two parts by a distinct groove on the surface; one of these, the smaller and posterior of the two, is the funiculus gracilis, or the posterior pyramid; and the anterior and larger part has been named funiculus cuneatus (Burdach). Between the restiform bodies is the space of the fourth ventricle at the back of the medulla. The *posterior pyramid* (funic. gracilis) is a continuation of that part of the spinal cord which is close to the posterior median fissure. By drawing forwards the medulla, or using a separate piece of hardened medulla, the pyramid will be seen to be slightly enlarged (clava) at the apex of the fourth ventricle, where the restiform bodies diverge, and then to become gradually indistinct on the surface of the corpus restiforme.

of what parts it consists.

Posterior pyramid is close to posterior median fissure.

Obex.

Where the posterior pyramidal bodies separate they are connected by an intervening band or cross piece (obex, Riegel of the Germans), that closes behind the point of the fourth ventricle. A little higher on each side is a thin lamina of nervous substance (tænia, ligula), which is about a line in width, and forms part of the roof of the fourth ventricle; this membranous piece is at-

Tænia of pyramid.

tached by one edge to the hinder part of the restiform body, but is free by the other, where it is connected with the vascular fold of the ventricle.

Structure.— The elements of the spinal cord, viz. anterior, middle, and posterior columns, are continued into the lower part of the medulla oblongata, where they can at first be recognised; but they soon become mixed together, and have an arrangement different from that of the cord. Fibres of the medulla.

Dissection. — In the pyramid two sets of fibres have to be shown, — one from the same, and one from the opposite side of the cord. The fibres from the opposite half of the cord will appear in the median fissure, when the pyramids are gently drawn from one another, where they are named the decussating fibres; and to lay these bare more completely, the small part of the anterior column of the cord on their side, that remains below the cross fibres (for the cord has been cut through near these), may be forcibly detached from its position, and turned outwards. The fibres to the pyramid from the same half of the cord will be demonstrated by everting the anterior column below the decussation, as on the other side. Dissection to trace the pyramid.

The *anterior pyramid* receives fibres, inferiorly, from the anterior column of the cord of its own side, and, internally, from the lateral column of the opposite half of the cord. The inner set of fibres are deep at their origin, but they become superficial in the median fissure, and are then directed upwards, close to that fissure, so as to push outwards the inferior fibres continued from the anterior column; and as the inner fibres of each pyramid are derived from the lateral column of the opposite side, they cross each other in the anterior median fissure of the spinal cord: — thus they form the decussation of the pyramids. Fibres of anterior pyramid. Derivation

The pyramid is continued into both the cerebrum and cerebellum. Its fibres are white and longitudinal, and are collected into a bundle of a prismatic form. Superiorly most of the fibres enter the pons, to reach the cerebrum, but two offsets proceed from the outer side. One is very small and superficial, and is directed below the corpus olivare to the restiform body and the cerebellum; the other invests the olivary body so as to be thickest on the sides, and receiving and distribution.

a band from it, enters the pons as the olivary fasciculus, or the fillet.

Olivary body

The *olivary body*, and its *fillet.*—When the olivary body has been sliced obliquely; it will be seen to consist of a wavy yellowish line, surrounding a centre or nucleus of whitish matter; and this toothed appearance has been named corpus dentatum. The zigzag bounding line is the cut surface of a thin capsule or bag, which has the dilated part towards the surface, and the narrowed part or neck open and directed backward. A band of fibres issues from the nucleus by the aperture in the posterior part of the capsule, and uniting with the longitudinal fibres of the pyramid around the corpus olivare, forms the olivary fasciculus or the *fillet;* thus blended both ascend to the cerebrum.

is an incomplete sac open behind.

A band issues from it.

Dissection of lateral and restiform pieces.

Dissection.—For the purpose of seeing the arrangement of the fibres of the lateral column and restiform body, the anterior pyramid is to be cut across on the left side, between its decussation and the olivary body, and to be raised together with this body towards the pons. Afterwards the remaining part of the pyramid is to be separated by dividing the fibres it receives from the decussation.

Lateral fibres of cord

The *lateral tract* of the medulla is continuous inferiorly with the portion of the spinal cord between the anterior and posterior roots of the nerves, and is prolonged superiorly in greater part to the cerebrum, but it gives an offset to the cerebellum. Soon after entering the medulla oblongata, it is divided into three sets of fibres, external, internal, and middle. The external fibres are both superficial and deep, and, joining the restiform body, reach the cerebellum; the internal offset enters the pyramid of the opposite side; whilst the middle fibres, the continuation of the column, ascend beneath the olivary body, and leaving the surface of the medulla at the pons, incline backwards and inwards to the floor of the fourth ventricle (where they form the eminentia teres), in their course to the cerebrum.

are much mixed in medulla,

and pass deeply.

Decussation of pyramids formed by lateral columns.

The decussation of the pyramids is formed by the crossing of the internal fibres of the lateral columns before they enter the pyramid of the opposite side. This interweaving of the fibres occupies the anterior groove of the medulla oblongata, at the distance of three quarters of an inch from the pons,

and is about a quarter of an inch in length. In it will be found three or four bundles of fibres from each side.

Restiform body. The *restiform body* is divided between the cerebrum and the cerebellum. Inferiorly, it is continuous with the posterior column of the cord; and accessory fibres are continued to it, in front, from the anterior pyramid, and from the lateral column. Superiorly its fibres are continued to both the large and the small brain in the following manner: — The wedge-shaped part (funic. cuneatus) divides into two rather above the point of the fourth ventricle; the external offset bends outwards to the cerebellum without entering the pons, whilst the inner one is continued with the slender fasciculus (funic. gracilis, p. 202.) or posterior pyramid, along the floor of the fourth ventricle, joining the fasciculus teres of the same side, into the peduncular fibres of the cerebrum (p. 211.).

Enters cerebrum and cerebellum.

Commissural fibres. *Arched* or *commissural fibres* of the medulla. — In each half of the medulla oblongata are fibres directed almost horizontally from behind forwards, both on its exterior, and through its substance. And in the middle line the same system of fibres forms a *septum* or *raphé* between the opposite halves.

Origin. The transverse fibres, both the outer and inner, seem to be derived from the restiform body and the crus cerebelli: — the *external* set more or less marked in different bodies cross, on the front of the medulla, the olivary and pyramidal bodies, and some may be seen entering the median fissure; below the olivary body they often form a band, the *fibræ arciformes* of Rolando. At the back of the medulla some may be seen issuing from the median fissure, and crossing that part, to enter the auditory nerve and the crus cerebelli. The *internal* set can be seen only on sections of the hardened and prepared medulla: they penetrate all the fibres of the medulla, except the anterior pyramid, and end at the middle line; in their course they perforate the gray capsule of the olivary body as well as its contiguous deposit, and are said by Stilling to constitute the white substance of the former.

Arrangement of outer set and inner set.

Septal fibres. The *septum* consists of both antero-posterior and transverse fibres. The antero-posterior reach from the one median fissure to the other, and consist of two strata, one casing each half of the medulla. These fibres are continuous with the external set, but some of the inner transverse seem to be added to them. Between the two strata of antero-posterior fibres is a slight interval, which is oc-

cupied by the inner transverse fibres that cross from the one half to the other of the medulla.

Gray matter, two kinds; *Gray matter* of *medulla oblongata.* — In the medulla oblongata there is the continuation of the gray matter in the interior of the spinal cord, and there are also some special deposits. Cross sections would be required to see completely its arrangement.

some continuous with that in cord. In the lower part of the medulla the gray substance has the same arrangement as lower down in the cord, viz. a central transverse part with a crescentic piece on each side, but it gradually loses that regular arrangement above, and becomes blended with the white substance. Thus the part corresponding to the central or transverse commissure of the cord is laid bare behind, in the fourth ventricle, in consequence of the restiform bodies being removed from the middle line; there it forms a stratum for the floor of that space and is continued chiefly amongst the fibres of the lateral tracts. The crescentic half of the gray matter of the cord, more especially its hinder part, comes to occupy the restiform body, and then to be continued upwards amongst the fibres. In the restiform body it reaches the surface as a gray streak (gray tubercle of Rolando).

Special deposits; behind, before. The special deposits are at the fore and hinder parts: — Those behind are chiefly nerve nuclei, and will be noticed with the fourth ventricle (p. 240.); those in front are in connection with the anterior pyramids, or with fibres derived from these — Firstly, there is the thin wavy stratum, that forms the corpus dentatum in the olivary body (p. 204.). Next, outside this, and towards its upper and outer end, is another small collection (Olivennebenkern, Stil.), which appears as a flattened yellow streak, and has the same structure as the dark stratum of the olivary body. Lastly, Stilling describes one collection in the anterior pyramid, near the olivary body; and another, external to the nucleus by the side of the olivary body, in the fibres that are continued from the pyramid around the olivary body.

PONS VAROLII.

Pons: The PONS, or ANNULAR PROTUBERANCE (pons Varolii, nodus encephali), is situate above the medulla oblongata, and position, between the hemispheres of the cerebellum. In its natural position in the skull it fills the hollow in front of the tentoform rium cerebelli. It is nearly of a square shape, though it is rather widest from side to side, and measures two inches in surfaces the last direction. The anterior surface is grooved along

the middle line, and is received into the basilar hollow in the base of the skull. By the opposite surface the pons enters into the fourth ventricle, forming part of the floor of that space. The upper border is longest and most curved, and arches over the cerebral peduncles; and the lower border overlays the prolongations of the medulla oblongata. On each side is the crus cerebelli, whose fibres radiate over the surface. and borders.

Structure. — In the pons are alternating strata of transverse and longitudinal fibres: the transverse set are continuous with the fibres of the crus cerebelli, and are interspersed with much gray matter: the longitudinal are prolonged from the constituent bodies of the medulla oblongata. It is formed by longitudinal and transverse fibres.

Dissection. — The transverse fibres of the pons may be divided along the line of the pyramidal body of the left side, and turned outwards, so as to denude the longitudinal fibres of the pyramid. In like manner a second mass of transverse fibres, which lie below those of the pyramid (first longitudinal set) may be cut through outside the pyramidal; and the deep fibres of the lateral and posterior columns of the cord (second longitudinal set) will appear. Amongst this last set of longitudinal fibres is the fillet of the corpus olivare, which the dissector should attempt to trace upwards from that body. The superficial fibres of the pons can be seen on the side that is untouched. Dissection to expose the fibres.

The *transverse fibres* of the annular protuberance are collected chiefly into two strata — a superficial and deep, which are united in the middle line: they serve as commissural fibres of the cerebellum, and are derived from the crus or middle peduncle of that body. There are a few other transverse, that will be described with the septum. The transverse fibres form a

The superficial set are mostly horizontal, but some from the lower part of the crus ascend obliquely over the others to reach the upper margin of the pons. superficial and

The deep layer is thickest, and contains much gray matter between its fibres. a deep layer.

The *longitudinal fibres* consist of three sets, viz. one from the anterior pyramidal body; another from the lateral and posterior columns of the cord; and a third from the corpus olivare. These are not simply continued through the pons, but are increased in number by the addition of special fibres Three sets of longitudinal fibres.

(peduncular, Stilling), that begin in the upper two thirds of the pons and join them on the outer side. It is said by some, that the transverse fibres of the pons become longitudinal, and thus increase the number.

from anterior pyramid, *a.* The fibres of the anterior pyramid pass through the pons between the two sets of transverse fibres, but not as one mass, for they are divided into a number of small bundles in their progress. Much increased in number, the fibres enter the crus cerebri at the upper border of the pons, and give rise to that fasciculated surface of the peduncle, which is now uppermost.

from lateral and posterior part of spinal cord, *b.* The ascending fibres of the lateral and posterior columns of the cord are altogether deeper than the commissural fibres of the pons, and are mixed up with gray matter; they are also more numerous than the preceding set. These fibres project close to the middle line, in the floor of the fourth ventricle, and form the eminence of the fasciculus teres; from that spot they are continued upwards to the crus cerebri, where they enter its deeper or cerebral part. In the pons a band from the olivary fasciculus is added to these fibres.

from olivary body. *c.* The olivary fasciculus (fillet, p. 204.) divides into two slips in the pons. One passes backwards to the upper (in this position deeper) part of the crus cerebri, and ends in and beneath the corpora quadrigemina (p. 229.). The other is continued to the cerebrum with the fibres of the lateral column.

Septum of pons. *Septum.*—In the pons, as in the medulla oblongata, there is a septum between the halves, but only at the posterior part, for anteriorly the transverse or commissural fibres of opposite sides are continuous. It consists like that of the medulla oblongata of antero-posterior and transverse fibres.

Antero-posterior fibres. The *antero-posterior fibres* are derived partly from the floor of the fourth ventricle; and partly from the transverse of the pons, which bend backwards for a certain distance before they cross to the opposite side.

Transverse. The *transverse fibres* of the pons, opposite the septum, are very slender, and are seen only on transverse sections of a hardened pons; they come from the floor of the fourth ventricle, pierce the longitudinal fibres, and are then continued across the middle line, between the antero-posterior, as in the medulla oblongata.

Section IV.

DISSECTION OF THE CEREBRUM.

The cerebrum, or the great brain, is the largest of the parts into which the encephalon is subdivided. It may be said to fill that part of the cavity of the skull, which is above a circular line on a level with the eyebrows and the occipital protuberance. Situation of the cerebrum.

Taking the general form of the skull, the cerebrum is convex on the upper aspect, and uneven on the lower aspect. It consists of two hemispheres, which are placed side by side, and are partly separated by a median or longitudinal fissure; but in the middle line the halves are united by certain interior parts (commissures), as well as by several connecting structures at the under surface. Superiorly the surface of the hemisphere is entire, but inferiorly it is divided into lobes. Form: has two hemispheres joined by median parts.

Under Surface, or Base of the Cerebrum. — At its under part the cerebrum is very irregular, in consequence of its fitting into the inequalities of the base of the skull; and on this aspect the separation into hemispheres is not complete, as on the upper surface, for the median fissure exists only at the fore and hinder parts. The following objects are to be recognised at the base of the brain: — Under surface of cerebrum.

On the under surface of each hemisphere, about one third from its front, is the fissure of Sylvius, which divides it into two. Of these the fore part constitutes the anterior lobe; and the hinder large part consists of middle and posterior lobes, but there is not any groove to mark the separation between them, the anterior border of the cerebellum being taken as the limit between the one and the other. Division of the hemisphere.

In the middle line, in front of the pons, are the two large white masses of the peduncles of the cerebrum (crura cerebri), one belonging to each hemisphere; and between them is a space perforated by vessels, which is named locus perforatus posticus. Outside the peduncle is the optic tract, and between it and the inner part of the hemisphere is a fissure leading into the lateral ventricle. Proceeding forwards in the middle line, the student will find two white And parts along the middle line.

bodies like peas, the corpora albicantia; and in front of these a grayish mass, called tuber cinereum. From the tuber cinereum a conical reddish tube, the infundibulum, descends to the pituitary body in the sella Turcica of the sphenoid bone. Anterior to this same mass (tuber cinereum), are the converging optic tracts with their commissure. Beneath the commissure of the optic nerves lies a thin grayish layer (lamina cinerea); and still farther forwards is the anterior part of the great longitudinal fissure between the hemispheres, with the white corpus callosum in the bottom of it. At the inner end of the fissure of Sylvius is another spot, perforated by vessels, and distinguished by the name substantia perforata, or locus perforatus anticus.

Parts of convolutions of corpus callosum, Parts of some special convolutions may now be seen. One convolution, that of the corpus callosum (gyrus fornicatus), is visible at its beginning and ending; its anterior part is in contact with the body from which it takes its name, and its posterior extremity rests on the outer side of the crus cerebri.

of median fissure, Another is the convolution of the margin of the great median fissure, which is bare at its anterior part, and contains the olfactory nerve in a groove on its surface.

of fissure of Sylvius. A third large convolution surrounds the fissure of Sylvius; and in that fissure are some other small convolutions, which will be examined with it.

The several parts of the base of the brain are now to be noticed more in detail.

Three lobes in each hemisphere; *Lobes of the cerebrum.*—There are three lobes in each hemisphere, but this division into parts is confined to the under surface. The *anterior* lobe is triangular in form, and anterior, the apex is turned backwards; it is somewhat excavated on the surface now seen, which, in the natural position of the brain, rests on the orbital plate of the frontal bone. The middle, olfactory nerve lies near the inner margin. The *middle* lobe is the most prominent of the three, and projected, before the brain was removed, into the middle fossa of the base of the skull. The fissure of Sylvius intervenes between it and the osterior. anterior lobe. The *posterior* lobe has no fissure to separate it from the middle one; its extent forwards is determined, as before said, by the anterior or outer margin of the cerebellum. This lobe would not be in contact with the base of

the skull, supposing it in position, but would be supported on the tentorium cerebelli.

The *fissure of Sylvius* is directed outwards between the anterior and middle lobes, and branches externally into two parts, one of which passes before, and the other behind some small convolutions, to which the term island of Reil has been applied. At the inner extremity of the fissure is a narrowed point, corresponding to a subjacent band of white fibres (fasciculus uncinatus) that connects the two lobes. Fissure of Sylvius

Surrounding the cleft is the *convolution of the Sylvian fissure*, which is much bent as it makes the circuit; it is joined internally by the convolutions in the fissure, and externally by convolutions on the outer surface of the hemisphere of the cerebrum. is surrounded by a convolution,

The *island of Reil* consists of five or six small, short convolutions, which lie in the Sylvian fissure, and are concealed by the anterior and middle lobes in the natural condition of the parts. These convolutions are connected with the large convolution around the fissure. and contains other convolutions.

Peduncle of the cerebrum (crus cerebri).—This is a large, white, stalk-like body, which reaches from the upper border of the pons to the under part of the cerebral hemisphere of the same side near the inner margin. Each is about three quarters of an inch long, and widens as it approaches the cerebrum. Crossing its outer surface is the optic tract; and between the crura of opposite sides is the interpeduncular space, which contains the locus perforatus, the corpora albicantia, and the tuber cinereum. Crus cerebri is fixed in the under part of hemisphere.

Structure. — The peduncle may be said to be formed by a continuation upwards of the longitudinal fibres of the pons, which enclose here a mass of gray matter between them. Formed of longitudinal fibres.

Dissection. — For the purpose of demonstrating the structure of the crus, say on the left side, the fibres continuous with the anterior pyramid should be cut across in the pons, and should be raised and carried forwards into the crus as far as the optic tract. In this proceeding the mass of gray matter (locus niger) will appear, and beneath it will be seen a second or deeper set of longitudinal fibres. Dissection.

a. The superficial fibres, which form the cranial or free part of the crus, are continued from the anterior pyramidal body. They are longitudinal in direction, and coarse in Its superficial fibres

texture, and are directed upwards radiating to the cerebrum. The portion of the crus, which is composed of these fibres, is called the *fasciculated* portion, or the *crust.*

form crust ;

deep fibres

b. The deeper fibres are also prolonged to the cerebrum. They are derived chiefly from the lateral and posterior tracts or columns of the medulla oblongata, and from the olivary fasciculus (p. 204.). Some of the fibres of the lateral tract of one side cross offsets from the corresponding tract of the other, so that there is a decussation, like that in the pyramids, across the middle line ; and the peduncle consequently contains fibres that are continued from both sides of the medulla oblongata.* In addition to the longitudinal fibres derived from the medulla oblongata, are others coming from the cerebellum, which mix with the former: some of these decussate also across the middle line (see p. 238.). The fibres obtained from these sources are situate beneath (as now seen) the gray matter: besides being deeper, they are finer than the superficial set, and are interspersed with gray matter. The deeper part of the crus, viz. that at the cerebral aspect, is constructed by these fibres, and is named *tegmentum.*

decussate and

form tegmentum.

The gray matter.

c. The gray matter (locus niger) of the crus, is nearer the inner than the outer margin of that body, and is convex towards the free surface, but concave in the opposite direction.

Locus perforatus.

The *posterior perforated spot* (pons Tarini) is situate between the peduncles of the cerebrum ; grayish matter is present at this spot, and into it numerous vessels enter. This structure corresponds to part of the floor of the third ventricle.

Corpora albicantia.

The *corpora albicantia* (corp. mamillaria) are two small, white bodies, about the size of peas, which are formed in greater part, as it will afterwards appear, by the crus of the fornix. If one, say the left, is cut across, it will be found to contain gray matter. In front of them is a mass of gray substance ; and behind they are connected together by white brain substance.

* This is part of the median commissure of M. Foville, which reaches through the medulla oblongata, pons, and cerebral peduncles. See the work of M. Foville, entitled: *Traité complet de l'Anatomie, &c., du Système Nerveux cérébro-spinal*, p. 323.

The *tuber cinereum*, or the mass of gray matter behind the optic commissure, forms part of the floor of the third ventricle, and is continuous with the gray substance in that cavity. In front of it is the optic nerve, and from its centre projects the following: — The *infundibulum* (funnel) is a conically-shaped tube, that reaches to the upper part of the posterior lobe of the pituitary body. In the fœtus this tube is open between the third ventricle and the pituitary body, but in the adult it is closed inferiorly. It consists of a layer of gray matter, surrounded by the pia mater, and is lined by the membrane of the third ventricle as far as it is pervious. Tuber cinereum and infundibulum.

The *pituitary body* will be very imperfectly seen when it has been dislodged from its resting-place: therefore it should be sometimes examined in the base of the skull, by removing the surrounding bone. Its use is unknown. Pituitary body.

This body is situate in the hollow in the centre of the sphenoid bone (the sella Turcica), and consists of two lobes, anterior and posterior. The anterior is the largest, and is hollowed out behind, where it receives the posterior lobe. In the adult this mass is firm and solid in texture, and reddish in colour; but in the fœtus it is hollow, and opens into the third ventricle through the infundibulum. Situation.

This structure is firm and reddish externally, but softer and yellowish internally. In it are large vesicular nucleated bodies, which are embedded in a granular matrix. Structure.

Dissection. — To see the lamina cinerea and the anterior termination of the corpus callosum, the convolutions of the anterior lobe of the cerebrum may be removed on the left side, where they overlie those parts. The convolution (gyrus fornicatus) in contact with the corpus callosum may be divided, and its ends turned forwards and backwards. Dissection.

The *lamina cinerea* is a thin layer of gray substance, that extends backwards from the anterior termination of the corpus callosum to the tuber cinereum. This stratum closes the anterior part of the third ventricle, and is continuous laterally with the anterior perforated spot. In consequence of its great thinness, this structure is often broken through in removing the brain. Gray lamina.

The *corpus callosum* is now seen to be bent in front, and then to be extended horizontally backwards in the longitudinal fissure to a spot within a quarter of an inch of the Corpus callosum

ends inferiorly in two bands,

and extends laterally into hemisphere.

Its convolution.

anterior commissure, where it presents a well-marked concave margin, to which the lamina cinerea is joined. A white band, fillet or peduncle of the corpus callosum, is continued onwards, on each side, from the line of termination before alluded to, to the anterior perforated spot. To the anterior bend of the corpus callosum the term knee (genu) is applied, and to the prolonged central part the appellation beak (rostrum) has been given. Laterally the corpus callosum reaches into the anterior lobe, and bounds the lateral ventricle in the same direction, so that an incision through it would open that cavity. In contact with this now denuded surface of the corpus callosum is the convolution named gyrus fornicatus, which may be seen to begin by a narrow part in front of the anterior perforated spot.

Substantia perforata antica.

Anterior perforated spot (substantia perforata antica) is a space near the inner end of the fissure of Sylvius, which is situate between the anterior and middle lobes of the cerebrum, and in front of the optic tract. On the inner side it is continuous with the lamina cinerea, and crossing it, from within outwards, is the fillet of the corpus callosum. This space is gray on the surface; it corresponds with the corpus striatum in the interior of the brain, and is perforated by numerous vessels for that body.

Position of brain to examine upper part.

Position of the part.— Now the base of the cerebrum has been dissected, the brain should be turned over for the examination of the upper part. After the brain has been turned something should be placed beneath the anterior lobes, in order that they may be raised to the same level as the posterior; and a rolled up cloth should encircle the whole, to support the hemispheres.

Cerebrum is convex above, and divided into two.

Upper Surface of the Cerebrum.— On the upper surface the cerebrum, taken as a whole, is oval in form, with the larger end backwards, and is convex in its outline, in accordance with the shape of the skull. The cerebral mass is only partly separated into two portions or hemispheres by a median longitudinal fissure; for the corpus callosum extends from one hemisphere to another, and interrupts the depth of the fissure at the middle part, but before and behind that connecting piece its separation into two halves is complete.

Each half

Each hemisphere is smaller in front than behind. Its

outer surface is convex ; but the inner is flat, and in contact with the opposite hemisphere at the fore part. On the upper aspect the surface of the hemisphere is not cleft by fissures into lobes, but on the under aspect it is separated into two pieces by the large sulcus before seen. The superficies of the hemisphere is marked by tortuous eminences, similar to those of the convoluted small intestine ; the projections on it are named convolutions or gyri, and the intervening depressions, sulci or anfractuosities.

is marked by convolutions and sulci.

Convolutions.— Of the numerous convolutions the student may notice the following as the most regular :— one on the corpus callosum ; another at the margin of the longitudinal fissure ; and some others on the outer surface of the hemisphere. The convolution of the Sylvian fissure has been already noticed (p. 211.).

Chief convolutions.

Dissection. — The upper part of each hemisphere having been already cut off as low as the convolution of the corpus callosum, that convolution is to be cut through on the left side, and its ends turned forwards and backwards ; a white longitudinal band (covered band of Reil) will be seen beneath it. It is supposed that the top of one hemisphere has been kept for the purpose of examining the convolutions.

Dissection.

a. The *convolution of the corpus callosum* (gyrus fornicatus) extends around the root of the hemisphere, except at the fissure of Sylvius. It is narrow in front, and begins at the anterior perforated spot; then courses round the corpus callosum and the crus cerebri, and ends at the posterior part of the same spot. Whilst lying on the inner surface of the hemisphere, it is joined by the convolutions of that part. Beneath this convolution is a band of fibres — the covered band of Reil, fillet of the corpus callosum, which is connected in front and behind with the anterior perforated spot, and gives offsets to the secondary convolutions in the median longitudinal fissure.

Convolution of corpus callosum; its fillet or band.

b. The *convolution of the margin of the longitudinal fissure* takes a similar course with the preceding around the hemisphere, but it lies at the margin of the great median fissure, instead of being placed deeply in it. Commencing at the anterior perforated spot, where it forms the inner part of the anterior lobe (p. 210.), it is directed back along the margin of the great fissure, and along the under part of the hemisphere to the front of the middle lobe. This is not so distinct as the preceding convolution.

Convolution of longitudinal fissure.

c. The *convolutions of the outer surface* of the hemisphere cross

Convolutions of

outer part of cerebrum.

more or less obliquely, from the convolution of the margin of the great median fissure to the convolution of the Sylvian fissure. The posterior are most oblique and become irregular. On opposite sides of the brain these convolutions are not symmetrical.

A convolution has base and summit;

Structure of the convolutions. — From the section now made into the brain, it may be perceived that each convolution is continuous with the interior of the brain on the one side (base), and that it is free on the surface of the brain on the other side, where it presents a summit and lateral parts.

is gray outside

Externally it consists of a layer of grayish cerebral substance as a cortical layer, which is continued from one eminence to

and white within.

another over the surface of the hemisphere; and internally it is composed of white brain substance — its medullary part, that is derived from the fibrous mass in the interior.

Its structure.

On a closer examination the cortical layer is found to be composed of three strata: — an outer white stratum, an inner reddish-yellow one, and an intervening gray lamina. The outer white stratum differs in development in different parts of the brain, and is most marked over the hinder and lower portions of the convolution of the corpus callosum, where it is pierced by minute holes. The inner stratum equals in thickness the other two, and has on its external surface also a thin white lamina, so that white and gray laminæ will alternate with one another in the gray matter of the convolutions.

Sulci.

The *sulci*, or the intervals between the convolutions, vary in size in different parts of the brain; they are deepest generally on the outer aspect of the hemisphere, where they measure about an inch.

The deepest where found.

There is one of considerable depth on the inner surface of the hemisphere, on a level with the corpus callosum, which projects inwards beneath an eminence (hippocampus minor) in the floor of the lateral ventricle. From it another sulcus is directed vertically upwards to the convex part of the hemisphere.

Composition.

INTERIOR OF THE CEREBRUM. — When viewed from the outer surface, the cerebrum appears like a twisted tube, but when a cut has been made into it, it will be found to be solid, with a convoluted crust or exterior.

Outline

Each half of the brain consists of a foot stalk or peduncle,

and of a dilated part or hemisphere; and the following description may serve as an outline of the general arrangement of its constituents: — Connected with the base of the foot stalk, where it joins the hemisphere, are certain central or fundamental bodies; and in the interior are some connecting pieces, that join together distant parts of the brain. In the middle, is a large central space, which is subdivided into smaller hollows or ventricles by the before-mentioned connecting pieces. And the whole, except the foot stalk, is surrounded by a convoluted crust. of hemisphere.

The fundamental parts of the hemisphere are the crus cerebri, and two masses of gray substance — corpus striatum and optic thalamus, which are situate above the crus: the last two bodies are sometimes called ganglia of the brain, because the fibres of the peduncle, whilst passing through them, are increased in number. The connecting pieces, which are named commissures, pass from the one hemisphere to the other, across the middle line of the brain, or connect together portions of the same half of the cerebrum: some of the commissural pieces serve as bounding parts of the ventricles. Fundamental bodies, and commissures.

In conducting the dissection of the cerebrum, the student will have to learn the form and situation of the several constituent parts, and afterwards to trace the connections between these by means of fibres.

Hemisphere above the ventricles. — In the right hemisphere, which has been cut through above the level of the convolution of the corpus callosum, the surface displays a white central mass of an oval shape, the centrum ovale minus, that sends projections into the several convolutions. In a fresh brain, this surface is studded with drops of blood which escape from the divided vessels. Centrum ovale minus of the hemisphere.

When the hemispheres have been sliced off to the level of the corpus callosum, a much larger white surface comes into view, which has been named larger oval centre — centrum ovale, Vieussens. The white mass in each hemisphere may be further seen to be continuous across the middle line of the brain, where it is connected by a narrowed part, — the corpus callosum. Centrum ovale majus is deeper.

The *corpus callosum* reaches from the one half of the cerebrum to the other, and forms the roof of a space (lateral Corpus callosum.

ventricle) in each hemisphere; but between the halves of the brain, where it occupies the longitudinal fissure, this body is of less extent. Here it is about four inches in length, and somewhat arched from before backwards; it is also narrower in front than behind, and extends nearer to the anterior than the posterior part of the cerebrum.

Situation and form.

Upper surface has transverse and longitudinal fibres.

On the upper surface the fibres are directed from the hemispheres to the middle line, — the middle ones being transverse, but those from the anterior and posterior parts oblique. Along the centre is a mark or raphé, and close to it are two or more longitudinal white lines (nerves of Lancisi). Still further out may be seen other longitudinal lines (covered band, p. 215.) beneath the convolution resting on the lateral part of the corpus callosum. The longitudinal fibres in the middle line are continued downwards in front, and joining a prolongation from the covered band or fillet on the side, are continued to the anterior perforated spot.

Anterior part bends down.

In front the corpus callosum is bent to the base of the brain, as before seen (p. 213.); and behind, it ends in a thick roll which is connected with the subjacent fornix.

Dissection.

Dissection.—In order to see the thickness of the corpus callosum, and to bring into view the parts in contact with its under surface, the cut already made through that body into the ventricle is to be extended forwards and backwards on the left side, as far as the limits of the cavity. Whilst cutting through the corpus callosum, the student may observe that a thin membraniform structure lines its under surface.

Is thickest at each end.

The corpus callosum is thicker at each end than at the centre, in consequence of a greater number of fibres being collected in a given space; and the posterior part is the thickest of all. Connected with the under surface is the septum lucidum or partition between the ventricles, and still posterior to that is the fornix.

Under part.

Use.

This body is the chief commissural part of the halves of the brain, and reaches laterally even to the convolutions, but its fibres are not distinct far in the hemisphere.

Dissection.

Dissection.—The lateral ventricle is to be dissected in the opposite hemisphere; and to prepare it for examination, as much of the corpus callosum and of the white substance

of the brain, as forms the roof of the cavity, is to be removed. A part of the ventricular space dips down in the middle lobe of the cerebrum towards the base of the brain; and to open it, a cut is to be carried outwards through the substance of the left hemisphere, and then downwards, also through the hemisphere, along the course of the hollow.

VENTRICLES OF THE BRAIN. — The ventricular spaces in the interior of the cerebrum are derived, as before explained, from the subdivision of the large central space, and are four in number. One extends into both halves of the brain; but commonly the part in each hemisphere is described as a separate ventricle (the lateral), so that these constitute the first and second. Another (third) occupies the middle line of the brain near the under surface; and another small one (fifth) is included in the partition between the large ventricles of the hemispheres. The fourth ventricle is situate between the cerebellum and the posterior surface of the medulla oblongata and pons.

Five ventricles are in the brain.

The *lateral ventricles* are two in number, one occupying each hemisphere; they are incompletely separated in the middle line by a septum, for they communicate by an aperture below that partition. The interior is lined by a thin stratum of nucleated epithelium, with, in some spots, a subjacent stratum of connective tissue.

Lateral ventricle.

Each is a narrow interval, which extends into the anterior, posterior, and middle lobes of the corresponding hemisphere. Its central part (body) is almost straight, but the points (cornua) by which it reaches into the different lobes are curved. There are three cornua in each, which have the following dispositions: — The anterior is directed outwards from its fellow in the other hemisphere. The posterior or the digital cavity is much smaller in size, and is bent inwards in the posterior lobe towards the one of the opposite side. And the inferior cornu, beginning opposite the posterior fold of the corpus callosum, descends in a curved direction in the middle lobe, with the concavity of the bend turned inwards.

Shape and position; three cornua.

For the purpose of examining its boundaries, the ventricle may be divided into an upper or horizontal, and a lower or descending part.

Consists of two parts.

One is horizontal. Its roof; The upper or horizontal part reaches from the anterior into the posterior lobe, and is shaped something like the Italic letter *f*. Its roof is formed by the corpus callosum. floor, Its floor is irregular in outline, and presents, from before and bodies along it. backwards, the following parts: — first, a small piece of the under part of the corpus callosum; next, a large gray, pear-shaped body, the corpus striatum; behind this, another large white projection, named optic thalamus; and between these two last bodies is a white line, tænia semicircularis. On the surface of the optic thalamus is a vascular fold of the pia mater, known as the plexus choroides, together with the thin white edge of the fornix. Close behind the optic thalamus is the beginning of a projection (hippocampus major), that lies in the floor of the descending part of the lateral ventricle; and in the posterior cornu is an elongated eminence, the hippocampus minor. Inner boundary. The inner boundary of the ventricle, or the septum ventriculorum, is a thin partition, which has been named septum lucidum; below the anterior Aperture between. part of this partition, opposite the front of the optic thalamus, is the aperture of communication (foramen of Monro) between the two lateral ventricles.

The descending part; The lower or descending part of the ventricle winds beneath the optic thalamus, and forms a curve like the half-roof; bent fore finger. Forming the roof, will be the optic thalamus floor, and the contiguous part of the hemisphere. In the floor is a large curved, convex eminence, somewhat indented at the end, which is called the hippocampus major; and along its concave margin is a thin white band — tænia, that and bodies on it. is prolonged from the fornix. External to the projection of the hippocampus is another white eminence, the pes accessorius, or eminentia collateralis. In this part of the ventricle is the vascular fringe of the plexus choroides: it enters by a fissure internal to the hippocampus.

Septum lucidum; The *septum lucidum*, or the thin partition between the ventricles, is a translucent part of the cerebral mass, which position, hangs vertically in the middle line between the corpus callosum form, and the fornix. It is somewhat triangular in form, with the larger part turned forwards, and the narrow or surfaces, pointed extremity directed backwards. Its surfaces look borders, to the lateral ventricles. The upper border is attached altogether to the under aspect of the corpus callosum; and

the lower border is joined in part to the fornix, but in front of this body it is connected with the under or prolonged portion (rostrum) of the corpus callosum. The septum consists of two layers, which enclose a space — the fifth ventricle; and each layer is formed of white substance, with an external coating of gray matter. Structure.

Dissection. — The space of the fifth ventricle will come into view by cutting through the part of the corpus callosum that remains in the middle line, and by detaching the anterior half from the septum lucidum, so that it can be raised forwards. Dissection.

The *ventricle of the septum* or the fifth ventricle exists in the anterior part of the ventricular partition, where the depth is greatest. Like the septum that contains it, its largest part is in front. In the adult it is a closed space, but in the fœtus it opens inferiorly into the third ventricle between the pillars of the fornix. Its surface has an epithelial covering like that in the lateral ventricles. Fifth ventricle.

Dissection. — The fornix should be next examined. To lay bare this body the posterior part of the corpus callosum should be detached with care from it, and thrown backwards; and the septum lucidum should also be removed from its upper surface. Dissection.

The *fornix,* or arch, is a thin white horizontal stratum beneath the corpus callosum, which, projecting on each side into the lateral ventricle, forms part of the floor of that cavity. It is triangular in shape, with the base turned backwards, and is continuous with the rest of the brain only by its apex and base, where it gives off processes or crura, both before and behind. Fornix; position and form.

At its posterior part or base, the fornix has the following arrangement: — In the middle line it joins the corpus callosum, whilst on each side it sends off a small riband-like band — tænia hippocampi, along the concave margin of the hippocampus major. Posterior and At the anterior part, or apex, it is arched over the foramen of Monro, opposite the front of the optic thalamus, and ends likewise in two processes or crura, which will be afterwards followed to the corpora albicantia and the optic thalami (p. 228.). anterior part. To the upper surface, along the middle line, the septum lucidum is attached. Each border is free in the corresponding lateral ventricle, where it Upper surface and borders.

rests on the optic thalamus, and along it lies the choroid plexus.

Under surface

If the fornix be cut across near its front, the foramen of Monro will be opened, and the descending anterior pillars will be seen. When the posterior part is raised, the fornix will be found to be supported on a process of the pia mater, named velum interpositum; and at its base (on the under aspect) between the two offsets, or the tæniæ hippocampi, is

marked by lines.

a triangular surface, which is marked by transverse and sometimes by longitudinal lines: the surface which is so defined has been called by some (incorrectly) the lyra.

Fornix formed of two bands.

The fornix may also be described as consisting of two bands, right and left, which are united for a certain distance in the central part or body. According to this view, each band, commencing in the optic thalamus, passes over the foramen of Monro, and, after forming the body of the fornix, is continued as a distinct piece to the surface of the hippocampus.

This aperture joins lateral ventricles.

The *foramen of Monro* is the aperture beneath the anterior part of the fornix, in which the plexus choroides lies. Through it the lateral ventricles communicate with one another and with the third ventricle.

In floor of lateral ventricle are

FLOOR OF THE LATERAL VENTRICLE. — The student may leave untouched, for the present, the membrane on which the fornix rests, and proceed to examine, on the left side, the different bodies that have been enumerated as constituting the floor of the lateral ventricle.

striate body in front.

The *corpus striatum* (superior ganglion of the cerebrum), is the large gray body in the anterior part of the lateral ventricle. It has received its name from the striated appearance that it presents on a section being made through it; and it corresponds, externally, to the island of Reil in the fissure of Sylvius.

Dissection for structure.

Dissection. — To see the structure of the corpus striatum, the student should make a cut in it from before backwards, until certain white fibres, crossing it obliquely from within outwards, are reached. The knife should then be carried through this layer of white fibres until another mass of gray substance, similar to the first, is arrived at.

Its form,

The striate body now appears to be a conical mass of gray

matter of considerable thickness, which is surrounded by the white substance of the hemisphere, except where it projects into the lateral ventricle. Its position is oblique with respect to the middle line of the brain, for the anterior part is near the septum of the ventricles, whilst the posterior part is external to the optic thalamus. By means of the incision that has been made into the corpus striatum, white fibres can be seen to be directed through it in such a way as to divide the mass of gray matter into two parts, — one being situate in the ventricle (intraventricular) above the white fibres, and the other outside the ventricular space, below those fibres (extraventricular).

position; is divided into two parts by white fibres.

a. The *intraventricular* part (nucleus caudatus) of the striate body is pear-shaped, and projects into the floor of the ventricle. The end, directed forwards, is large and rounded; whilst the opposite end is thin and pointed, and is continued backwards, outside the optic thalamus, to the roof of the descending cornu of the lateral ventricle. Numerous veins cover this part of the corpus striatum.

One part in the ventricle,

b. The *extraventricular* part (nucleus lenticularis) will be best seen, afterwards, by sections made from the outer side or from below. It is oval in form, but does not reach so far back as the other, and is bounded inferiorly by a white capsule; through it the anterior commissure of the brain passes very obliquely, as a subsequent dissection will show.

the other outside that cavity.

The *tænia semicircularis* is a thin white band of longitudinal fibres, that lies between the corpus striatum and the optic thalamus. In front this band becomes broad, and joins the pillar of the fornix; and behind, it is continued, along with the pointed end of the corpus striatum, into the white substance of the roof of the descending cornu of the lateral ventricle. Superficial to the anterior part of the tænia is a yellowish semi-transparent layer (lamina cornea), and beneath this some veins pass in their course to the veins of Galen.

Tænia semicircularis ends in inferior cornu.

The *optic thalamus* is only partly laid bare in this stage of the dissection, and its examination may be omitted till after the third ventricle has been learnt.

Optic thalamus

The *hippocampus minor* (calcar avis) resembles a cock's spur as it lies in the posterior cornu of the ventricle. It is pointed at its posterior extremity, and is covered on the free

Hippocampus in posterior cornu;

surface by a medullary layer which is continued to the corpus callosum. When it is cut across a gray stratum will be found beneath the white; and the eminence itself seems to be produced by the extension inwards of the sulcus at the posterior part of the inner surface of the hemisphere (p. 216.).

Hippocampus major in lower cornu; The *hippocampus major* is the curved projection in the floor of the descending cornu of the lateral ventricle. Convex on the surface that looks to the cavity, this body is curved in the same direction as the cornu, and has its concavity turned inwards. The anterior extremity is the largest, and presents two or three indentations, which give it the appearance of the foot of a carnivorous animal, hence the designation pes hippocampi. Along the inner or concave margin is the small band or tænia that is prolonged from the fornix; and beneath that band is a thin layer of gray matter, with a notched border, which has been named fascia dentata.

Dissection. *Dissection.*— To examine more fully the hippocampus, the parts of the corpus callosum and fornix, that remain in the middle line, should be divided, and the posterior lobe of the left hemisphere should be drawn backwards. When the pia mater has been removed from the inner side of the hippocampus, and this projection has been cut across, its structure will be manifest.

Structure of hippocampus. The hippocampus is covered on the ventricular surface by a medullary investment, in which the tænia, or the band of the fornix ends. On the opposite aspect this body is hollowed, and contains gray matter from the surface of the brain. Along the free margin of the hippocampus the gray matter projects in the form of a notched ridge, the fascia dentata.

Great transverse fissure *Transverse fissure of the cerebrum.*— By drawing the separated hemisphere away from the crus cerebri and the optic thalamus (the central parts of the cerebrum), and then replacing it, the dissector will comprehend the position, and the boundaries of the great cleft at the posterior part of the brain. This fissure is placed beneath the fornix, and extends downwards, on each side, from the middle line to the end of the descending cornu. It is bounded on the one side by the fornix and the hemisphere, and on the other by the peduncle of the cerebrum. Through this great slit the pia

mater passes into the brain, and forms the velum interpositum and the plexus choroides. Where the pia mater projects into the lateral ventricle, beneath the edge of the fornix, it receives a prolongation from the lining structure of the cavity, and thus the interval through which it enters is closed. base of brain. Pia mater enters it.

Parts in the Middle Line. — The student is now to return to the examination of the parts in the centre of the brain, viz. the fold of pia mater and its vessels; the third ventricle, and the parts connected with it. At the same time the optic thalamus is to be seen. Parts in the middle of brain.

The *velum interpositum* is the central part of the fold of the pia mater that enters the brain by the great transverse fissure. Triangular in shape, the membrane has the same extent as the body of the fornix, and reaches in front to the foramen of Monro. The upper surface is in contact with the fornix, to which it supplies vessels; and the lower surface looks to the third ventricle, and covers the pineal body, and a part of each optic thalamus. Along each side is a vascular roll of the membrane (choroid plexus). Velum, or fold of pia mater, is over third ventricle; its lateral part

The *choroid plexus* is the red, somewhat round, and fringed margin of the fold of pia mater in the interior of the brain. Its lower end is larger than the upper, and each is described as extending from the foramen of Monro to the extremity of the descending cornu. On its surface the choroid plexus is villous; and the villi are minutely subdivided, and covered by laminated (? ciliated) nucleated epithelium, like that on the surface of the ventricle. is the choroid plexus of the lateral ventricle.

Vessels of the velum. — Some small *arteries* have been already traced to the velum and the choroid plexus from the cerebral and cerebellar arteries (p. 191.). These supply branches to the surrounding cerebral substance. The *veins* of the choroid plexus receive branches from the ventricle, and end in the following. Vessels of the velum. Arteries; veins;

Along the centre of the velum are two large veins, *veins of Galen*, which begin at the foramen of Monro, by the union of branches from the corpus striatum and the choroid plexus. Lying side by side, these veins are usually united at the posterior part of the velum into one, which opens into the straight sinus. with those of Galen.

Dissection. — When the velum interpositum has been Dissection.

raised and thrown backwards, the third ventricle will be visible. In reflecting the piece of pia mater, the student must be careful of the pineal body, which would otherwise be detached. On the under surface of the velum are the choroid plexuses of the third ventricle.

Other choroid plexuses. The *choroid plexuses* of the *third ventricle* are two fringed bodies beneath the velum, which resemble the like parts in the lateral ventricle.

Third ventricle is near base of brain. The *third ventricle* is an interval between the optic thalami, and reaches to the base of the brain. Its situation is in the middle line of the cerebrum, and below the level of the other ventricles, with which it communicates. Its boundaries and communications are given below: —

Roof. Floor. The roof is formed by the velum interpositum and the fornix. The floor is very oblique from behind forwards, so that the depth of the cavity is greater in front than behind: corresponding with the floor are the parts at the base of the brain, which lie between the crura cerebri and the anterior longitudinal fissure, viz. locus perforatus, corpora albicantia, tuber cinereum, commissure of the optic nerves, and lamina cinerea. Parts on the sides, in front, and behind. On the sides of the cavity the optic thalami are situate. In front of the space are the descending pillars of the fornix, with part of the anterior commissure of the cerebrum in the interval between them. Behind, are the posterior commissure and the pineal body. Crossing the centre of the space, from one optic thalamus to another, is a band of gray matter — the soft commissure.

Opening into other ventricles. This space communicates with the other ventricles of the brain in the following way: — In front it joins each lateral ventricle through the foramen of Monro, and opens into the fifth ventricle in the fetus. Behind is an opening into the fourth ventricle, beneath the posterior commissure, which is named aqueduct of Sylvius. At the lower part, in front, there is a depression opposite the infundibulum (iter ad infundibulum). The lining of the ventricle is continued into the neighbouring cavities through the different apertures of communication, and closes the iter ad infundibulum.

Gray matter of the ventricle. *Gray matter of the ventricle.* — A stratum of gray matter is seen to cover most of the surface of the ventricle. At the lower part of each optic thalamus it envelops the crus of the fornix, and ascends to the septum lucidum; and in the floor

of the cavity it also exists in abundance, entering into the corpora albicantia, and uniting the structures that form the floor of the third ventricle. In the middle of the space it reaches from side to side, and forms most of the soft commissure.

The *anterior commissure* of the cerebrum is a round bundle of white fibres, which passes through both corpora striata, and connects the opposite hemispheres. To see it in one half of its extent, the student should make the following dissection: — Anterior commissure: form and extent.

Dissection.—On the side on which the corpus striatum has been cut into, the commissure is to be followed into the interior of that body, by scraping away the gray matter (intraventricular) with the handle of the scalpel. The commissure may then be seen to perforate below the white fibres of the corpus striatum, and to pass through the other mass of gray matter (extraventricular) of the same body. To see it, open corpus striatum.

Free only in the middle line, where it lies before the pillars of the fornix, the anterior commissure perforates the corpus striatum, and passes in succession through the intraventricular gray mass, the white fibres, and the extraventricular gray matter. Lastly, the commissure pierces the white stratum bounding externally the corpus striatum, and ends in the roof of the inferior cornu of the lateral ventricle. Position; and course to roof of inferior cornu.

The *posterior commissure* of the cerebrum is smaller than the anterior, and is placed above the opening into the fourth ventricle. Laterally it enters the substance of the optic thalamus. Posterior commissure.

The *thalamus opticus* (inferior ganglion of the cerebrum) will be best seen on that side on which the inferior cornu of the lateral ventricle has been opened. It is a square-shaped body, which forms part of the lateral and third ventricles, and is free where it enters into those cavities. Thalamus opticus. Form and position.

The upper surface projects in the floor of the lateral ventricle, and is marked in front by a prominence — anterior tubercle, near the tænia semicircularis. The under surface forms part of the roof of the inferior cornu of the lateral ventricle, and into it the crus cerebri is inserted. By the inner side this body enters into the third ventricle; and along its upper part, on this aspect, lies the peduncle of the pineal body. On the outer side are the corpus striatum, and Upper surface. Under part. Inner side. Outer side,

anterior, and posterior parts. the substance of the hemisphere. The anterior part looks to the foramen of Monro. And the posterior part, which is free in the inferior cornu of the lateral ventricle, presents inferiorly two small roundish tubercles,—internal and external geniculate bodies, with which the optic nerve is connected.

Origin of optic nerve. The *origin* of the *optic nerve* from the thalamus, and from the geniculate and quadrigeminal bodies, can be now seen. At the back of the crus cerebri the optic tract receives fibres from the optic thalamus, which it touches, and then divides into two terminal bands:—one of these is connected with the gray matter in the external geniculate body, and is continued onwards to one of the corpora quadrigemina (nates); the other is similarly connected with the internal geniculate body, and then prolonged to the other quadrigeminal body (testis) of the same side.

Dissection. *Dissection.*—The origin of the fornix in the optic thalamus may be next followed out. But the anterior commissure and the anterior part of the corpus callosum should first be cut along the middle line, so that the left hemisphere can be separated from the other; on this (the left) the crus of the fornix is to be traced downwards to the corpus albicans, and then followed upwards into the optic thalamus.

Origin of fornix in optic thalamus; *Anterior pillar of the fornix.*—The fornix begins in the thalamus opticus, near the tubercle on the upper surface. From this origin it descends in a curved direction to the corpus albicans, where it makes a turn like half of the how forms corpus albicans. figure 8, and furnishes a white envelope to the gray matter of that body. The crus then ascends, being bent forwards, through the gray substance on the side of the optic thalamus, Joined by other fibres. and is joined by the fibres of the tænia semicircularis and peduncle of the pineal gland. Lastly, the crus is applied to the like part of the opposite side to form the body of the fornix.

The *pineal body* and the *corpora quadrigemina*, which are placed behind the third ventricle, may be next looked to.

Dissection. *Dissection.*—All the pia mater should be carefully removed from the surface of the quadrigeminal bodies, especially on the left side, on which they are to be examined. The posterior lobe of the hemisphere of the same side may be cut off.

The *pineal gland* (conarium) is a small conical body, which is situate above the posterior commissure, and between the anterior pair of the corpora quadrigemina. In shape like the cone of a fir, it is less than a quarter of an inch in length, and has the base or wider part turned forwards. It is connected to the optic thalami by two white bands,—peduncles of the pineal body: these begin at the base of the pineal gland, and extending forwards, one on each side, along the inner part of the optic thalami, end by joining the crura of the fornix. The base of the gland is further connected by transverse white fibres with the posterior commissure. Pineal gland; position, shape, attachment to thalamus.

This body is of a red colour and vascular, and encloses a cavity. It contains in its substance large pale nucleated cells, with a few nerve fibres, and much calcareous material. Structure.

The *corpora quadrigemina* are four small bodies, which are arranged in pairs, right and left, and are separated by a median groove. Each pair is situate on the cerebral aspect of the peduncle of the cerebrum of the same side. Corpora quadrigemina. In pairs on each side.

The anterior eminence (nates) is somewhat larger than the posterior, from which it is separated by a slight depression; it is oblong from before backwards, and sends forwards a white band to join the optic thalamus and the optic nerve. Anterior one (nates).

The posterior eminence (testis) is rounder in form and whiter in colour than the preceding: it has also a lateral white band, which is directed beneath the corpus geniculatum internum, and blends with the optic tract and the thalamus opticus. Posterior one (testis): both join thalamus.

These bodies are small masses of gray substance enveloped by white, and are placed on the band of the fillet that forms the roof of the aqueduct of Sylvius. They send processes (brachia) to the optic thalamus, which are accessory parts to the peduncular fibres of the cerebrum. Structure and their bands.

Fillet of the olivary body.—If the upper margin of the cerebellum be pulled aside, a white band, about a quarter of an inch in width, will be seen to issue from the transverse fibres of the pons, and to be directed upwards to the corpora quadrigemina. This is the upper or commissural piece of the fillet (p. 208.), which passes to the corpora quadrigemina, and joins beneath them, over the Sylvian aqueduct, with the similar part of the opposite side. Fillet of olivary body passes beneath corpora quadrigemina.

Three sets of fibres in cerebrum.

STRUCTURE OF THE CEREBRUM.—In each cerebral hemisphere three principal sets of constituent fibres are recognised, viz. diverging, and both transverse and longitudinal: the former are in part continuous with those of the spinal cord, and are supposed to form parts of the cerebrum; while the two latter join distant bodies, and are considered to be only connecting or commissural in their office.

Fibres of crus cerebri to the hemisphere.

A. *Peduncular or diverging fibres.*—In the crus cerebri or the root of the cerebral hemisphere, two bundles of longitudinal fibres are collected; these are separated, in part, by gray matter, and are derived mediately from the spinal cord (p. 211.). From this source the hemisphere may be said to spring.

Dissection of them

Dissection.—A complete systematic view of the diverging fibres cannot be given now, because the dissection necessary for that purpose would destroy parts that have not yet been seen. At this stage the purpose is to show chiefly the passage of those fibres from the crus through the two cerebral ganglia.

in the corpus striatum

To trace the diverging fibres onwards, beyond the crus cerebri, through the corpus striatum, the nucleus caudatus of that body should be scraped away from above them; and this dissection should be made on the side on which the striate body and the optic thalamus remain uncut. In this proceeding the pecten of Reil comes into view, viz. gray matter passing between the white fibres, and giving the appearance of the teeth of a comb.

and optic thalamus.

On taking away completely the prolonged part of the nucleus, others of the same set of fibres will be seen issuing from the outer side of the optic thalamus, and then radiating to the posterior and inferior lobes. After tracing those fibres, a part of the upper surface of the optic thalamus may be taken away at the posterior end to denude an accessory bundle to the peduncular fibres, which comes beneath the corpora quadrigemina from the superior peduncle of the cerebellum.

Fibres of peduncle diverge

Their *arrangement.*—The *diverging fibres* radiate from the peduncle of the cerebrum to the surface of the hemisphere, passing in their course through the two cerebral ganglia (optic thalamus and corpus striatum), and they form

a conically-shaped mass, whose apex is below and base above.

The fibres that form the free or fasciculated part of the peduncle pass mostly through the middle of the striate body; whilst those on the opposite aspect of the peduncle, which form its tegmentum, are transmitted chiefly through the under part of the optic thalamus, though some pass through both corpus striatum and optic thalamus. In those two ganglionic bodies the fibres are greatly increased in number; and in the optic thalamus, they receive accessory bundles from the superior peduncle of the cerebellum (p. 237.), from the fillet of the olivary body, from the pair of the corpora quadrigemina on the same side, and from the corpora geniculata. On escaping from the striate body and the thalamus the fibres radiate into the anterior, middle, and posterior parts of the cerebral hemisphere, forming the *corona radiata*. In the hemisphere the fibres are continued to the convolutions, but before reaching the circumference of the brain they decussate with the converging fibres of the corpus callosum. Their expansion in the hemisphere resembles a fan bent down in front and behind, forming thus a layer which is concave on the under side.

in corpus striatum and optic thalamus:

their accessory bands.

In the hemisphere they extend to convolutions.

Their *extent.* — It must not be supposed that all the fibres of the peduncle reach the surface of the brain, nor that all those at the circumference are originally derived from the peduncle; for some of the fibres of the crus cerebri end in the corpus striatum and the optic thalamus, especially the former; and others extend only from those ganglionic bodies to the surface of the hemisphere. Thus, in addition to the fibres that extend throughout, viz. from the crus to the surface, some connect the peduncle of the cerebrum with the ganglia, and others connect the ganglia with the convolutions on the exterior.

Fibres not reaching throughout.

Their *source.* — The fibres thus entering inferiorly the cerebrum through its peduncle, and continued thence to the periphery of the hemisphere, are derived from all three divisions of the medulla oblongata, viz. anterior pyramid, lateral column, and restiform body, and therefore directly from all the divisions of the spinal cord (p. 203.). The decussations between the fibres of opposite sides have been before referred to (p. 204, 212.).

Source from cord.

Commissural transverse fibres.

B. The *transverse commissural fibres* connect the hemispheres of the cerebrum across the middle line. These fibres give rise to the great commissure or the corpus callosum (p. 218.), and to the anterior and posterior commissures (p. 227.). All these bodies have been already examined.

Commissural longitudinal fibres are found in fornix and its accessory parts; and on, and under corpus callosum.

C. *Longitudinal fibres.* — Other connecting fibres pass from before backwards, uniting together parts of the same hemisphere, and having mostly a circular arrangement.

The fibres of this system are collected chiefly in the following different bands, viz. the fornix, the tænia semicircularis, and the peduncles of the pineal body. Other longitudinal fibres may also be enumerated on the upper and under surfaces of the corpus callosum, along the middle line; together with the band of the convolution of the corpus callosum: all these last are connected with the anterior perforated spot of the base of the brain.

Optic thalamus differs above and below.

Structure of the optic thalamus. — On making sections of the optic thalamus on the side on which it is entire (the left), this body will be found to consist of layers of gray and white substance, at the upper and inner parts; and of the medullary fibres (tegmentum) of the peduncle of the cerebrum, at the lower and outer parts.

Section of corpus striatum from outside.

Corpus striatum. —By slicing through the corona radiata on the right side, so as to bring into view the extraventricular part (nucleus lenticularis) of the corpus striatum, the extent and form of that mass, and the situation of the anterior commissure, will be apparent.

Section of crus cerebri.

Crus cerebri. — By a vertical section through the right peduncle of the cerebrum, the disposition and the thickness of the two layers of its longitudinal fibres, and the situation of the locus niger between them, may be perceived.

Proceeding to prepare cerebellum.

Dissection. — The cerebellum is to be detached from the remains of the cerebrum, by carrying the knife through the optic thalamus, so that the cerebellum with the corpora quadrigemina, the crura cerebri, the pons, and the medulla oblongata, may remain united together.

Parts to be separated from one another.

When the cerebellum, united with the other parts mentioned above, has been detached from the cerebrum, all the pia mater is to be carefully removed from the fissure on its under surface; and the different bodies in that fissure are to

be separated from one another. Lastly the handle of the scalpel should be passed along a sulcus at the circumference of the cerebellum, between the upper and under surfaces.

Section V.

THE CEREBELLUM.

The *cerebellum, little brain,* is flattened from above downwards, so as to be widest from side to side, and measures about four inches in this last direction. This part of the encephalon is situate in the posterior fossæ of the base of the skull, beneath the tentorium cerebelli. Like the cerebrum, it is incompletely divided into two hemispheres, — the division being marked by a wide groove along the under surface, and by a notch at the posterior part which receives the falx cerebelli.

Form and position of cerebellum.

Divisions.

Upper Surface. — On the upper aspect the cerebellum is raised in the centre, but is sloped towards the circumference. There is not any median sulcus on this aspect, and the halves are united by a central constricted part or isthmus, — the superior vermiform process. Separating this surface from the under one, at the circumference, is the horizontal fissure, which is wide in front, and extends backwards from the pons to the middle line of the cerebellum.

No groove on the upper surface; halves joined by median part.

The surface of the cerebellum is marked by plates or laminæ, instead of convolutions, which are notched on the sides, and form segments of circles, with their convexity directed backwards, and with a concentric arrangement. On the upper aspect the laminæ pass from the one hemisphere to the other, with only a slight bending forwards of the most anterior in the superior vermiform process; but on the under aspect they join the sides of the different bodies, or commissures, in the median fissure. Between the laminæ are sulci or fissures, which are lined by the pia mater, and reach to different depths: the shallower of these separate the laminæ; but the deeper limit the lobes, and reach downwards to the white substance of the interior. Here and there the sulci are interrupted by cross laminæ.

Laminæ and their arrangement.

Sulci are shallow or deep

A fissure is present below,

The UNDER SURFACE is convex, being received into the fossæ of the skull, and is divided into hemispheres by a median hollow (vallecula).

which is called valley, and contains vermiform process.

The central sulcus, or the vallecula, receives the medulla oblongata, and is wider at the middle than at either the anterior or the posterior part. In the bottom of the sulcus is a mass named inferior vermiform process, which corresponds with the central part connecting the halves of the cerebellum on the upper surface: the two together constitute the general commissure of the halves of the cerebellum.

Constituents of vermiform process.

Constituents of vermiform process. — Entering into the constitution of the inferior vermiform process are the following eminences, which may be easily separated from one another with the handle of the scalpel: — Most anteriorly is a narrow body, the *uvula*, which is named from its resemblance to the same part in the throat; it is longer from before backwards than from side to side, and is divided into laminæ. Its anterior projection into the fourth ventricle is named *nodule*, or laminated tubercle; and on its side is a ridge of gray matter, the *furrowed band*, which is notched on the surface and unites it with the almond-like lobe of the hemisphere. Connected with the nodule is a thin white layer on each side, — the *medullary velum;* but this and the furrowed band will be seen in a subsequent dissection (p. 235.). Behind the uvula is a tongue-shaped body, named *pyramid*, which is elongated from side to side, and is marked by transverse laminæ. Still farther back are certain transverse pieces extending between the posterior lobes of the hemispheres, of which they were considered by Reil to be the commissures.

Uvula, nodule, furrowed band, velum, pyramid, and commissures.

Seven lobes in each hemisphere,

LOBES OF THE HEMISPHERE. — Each hemisphere is subdivided into lobes on both the upper and the under aspect; and issuing from its anterior part is a large stalk-like process, which is subdivided into three pieces, and connects the cerebellum with other parts, viz. an upper offset to the cerebrum, a middle one to the pons, and an inferior one to the medulla oblongata.

and three peduncles.

Two lobes on upper surface,

On the upper surface there are two lobes, anterior and posterior, which are separated by a sulcus, but the interval between them is not well marked. The *anterior* or square

lobe extends back to a level with the posterior edge of the vermiform process; and the *posterior* reaches thence to the great horizontal fissure at the circumference.

On the under surface of the cerebellum, there are three lobes that are separated, as above, by sulci amongst the laminæ, but these are not more distinct than on the upper surface: — three on under surface. viz.,

Beginning behind, the student will meet first the *posterior lobe*, which joins the commissural laminæ behind the pyramid in the vallecula. Next in order is the *slender lobe*, which is connected with the posterior part of the pyramid, as well as with the other transverse laminæ behind that body. And lastly, attached to the side of the pyramid, is the *biventral lobe*. posterior, slender, and biventral.

Two other lobes appear between the biventral lobe and the medulla oblongata: — One of these is the *amygdaloid lobe*, which projects into the vallecula opposite the uvula, and touches the medulla oblongata. The other is a small pyramidal slip, that is directed outwards over (the under surface being uppermost) the crus cerebelli, and is named *flocculus*, or subpeduncular lobe. Two other lobes in valley; amygdaloid and flocculus.

Dissection. — To see the flocculus and the posterior medullary velum, the biventral and slender lobes of the under surface are to be sliced off, on the left side, so that the amygdaloid lobe may be everted. The flocculus is then bared, and passing from it to the tip of the uvula is the thin white layer of the posterior velum; beneath the last a bit of paper may be inserted. The furrowed band on the side of the uvula can be now fully seen. Dissection.

Flocculus and medullary velum. — The position of the flocculus to the crus cerebelli, and in front of the biventral lobe, has been before mentioned. This body resembles the other lobes in structure; and it may be considered a rudimentary lobe, for it is divided on the surface into laminæ, and contains a white medullary centre, from which offsets are furnished to those divisions. Position and structure of flocculus.

Passing from the flocculus to the tip of the inferior vermiform process (nodule) is a thin white layer, the *medullary velum* (inferior or posterior), which serves as a commissure to the flocculi. On each side this band is semilunar in form, its anterior edge is free, but its posterior border is attached Posterior medullary velum. Form and at-

tach-ments. in front of the transverse furrowed band. In front of the nodule the pieces of opposite sides are united, and form the membranous velum.

Cerebellum is solid internally. INTERIOR OF THE CEREBELLUM. — In the cerebellum there is not any cavity or ventricle enclosed as in the cerebrum. In the interior there is a large white centre, corresponding with that of the cerebrum, which furnishes offsets to the laminæ, and to other parts of the encephalon. The space of the fourth ventricle is between the cerebellum and the medulla oblongata.

Dissection of laminæ, *Dissection.*—For the purpose of seeing the structure of the laminæ, an incision may be made across them on the upper surface of the left hemisphere.

of centre, And the medullary centre, with its contained corpus dentatum, may be seen on the right side by removing all the laminæ from the upper surface. This proceeding may be accomplished by placing the scalpel in the horizontal fissure, at the circumference, and then carrying it inwards as far as the upper vermiform process, so as to detach the cortical stratum. If the corpus dentatum does not at first appear, thin slices may be made till it is reached. and corpus dentatum.

A lamina has white inside; *Structure of the laminæ.* — Each lamina consists of a white internal, and a gray external substance. The white part is derived from the central medullary mass, and dividing, like the branching of a tree, ends in small lateral offsets, that enter the subdivisions of the laminæ.

collateral white fibres; Besides the white stalk of the lamina, which is derived from the central mass, there are other white fibres that pass from one lamina to another.

and gray outside. The stratum of gray matter, that envelops the white substance, resembles somewhat the cortical covering of the convolutions of the cerebrum. It is constructed of two strata, inner and outer, that can be distinguished by the difference in their colour. The superficial stratum is gray, and about equal to the other in thickness; but the deeper one is of a rust-colour, and is generally thickest in the hollows between the laminæ.

White centre of cerebellum. MEDULLARY CENTRE. — In the centre of each cerebellar hemisphere is a large white mass which contains in its

substance a dentate body. From its surface offsets are furnished to the different laminæ; and from the anterior part proceed three large processes or peduncles — superior, middle, and inferior. gives offsets, viz.

a. The *superior peduncle* (processus ad cerebrum) is directed forwards towards the corpora quadrigemina (testis). It is rather flattened in shape, and forms part of the roof of the fourth ventricle: between the peduncles of opposite sides the valve of Vieussens is situate. Continuous behind with the inferior vermiform process, its fibres receive an offset from the interior of the corpus dentatum, and then pass beneath the band of the fillet, and beneath the pair of the corpora quadrigemina of the same side, to enter the crus cerebri and the optic thalamus. superior peduncle is above fourth ventricle.

Beneath the corpora quadrigemina the internal fibres of this peduncle are directed inwards, through those continued from the fasciculus teres, and cross the corresponding fibres of the other side, forming thus a decussation like that of the pyramids* (p. 204.). In this way the fibres of each peduncle end partly in the same, and partly in the opposite hemisphere of the cerebrum. Its fibres partly decussate.

Between the superior peduncles is the thin, translucent, white layer, — the *valve of Vieussens* (velum medullare anterius), which forms part of the roof of the fourth ventricle. It is thin and pointed anteriorly, but widens behind, where it is connected with the under part of the vermiform process. Near the corpora quadrigemina the fourth nerve is attached to the upper aspect of the valve, the nerves of opposite sides being united; and near the lower part, the upper surface is marked by some gray transverse ridges. Valve of Vieussens between the two.

b. The *middle peduncle* (processus ad pontem) is commonly named crus cerebelli, and is the largest of the three peduncular processes. Its fibres begin in the lateral part of the cerebellum, and are directed forwards to the pons, of which they form the transverse fibres, and in which they unite with the fibres of the peduncle of the opposite side. This peduncle is supposed to perform for the cerebellum, Middle peduncle is the commis-

* This intercommunication was known to Reil, and was named "ansa" by him, but the decussation has been noticed more recently by Stilling, *Ueber den Bau des Hirnknotens:* 1846.

sure of cerebellum. the same office as the corpus callosum does for the cerebrum, viz. to serve as a commissural or connecting piece.

Inferior peduncle. *c.* The *inferior peduncle* (processus ad medullam) passes downwards to the medulla oblongata, and forms part of the restiform body. Its fibres are connected chiefly with the laminæ of the upper surface of the cerebellum. It will be better seen when the fourth ventricle has been opened.

Fibres of middle peduncle, *Course of the fibres.*— The fibres issuing in the peduncles from the cerebellar hemisphere connect this with its fellow, with the cerebrum, and with the spinal cord of the same side. The description already given of the middle peduncle, both here and with the pons, will suffice for its fibres.

of upper, The fibres of the upper peduncle are continued into the crus cerebri, and thus form part of the diverging cerebral set of fibres; but before they reach their final destination there is a partial decussation with the fibres of the opposite peduncle, so that some from the right half of the cerebellum are continued to the left half of the cerebrum, and *vice versâ.*

and lower. The fibres of the lower peduncle enter the cord, and connect the cerebellum with all three portions of the half of the medulla oblongata of the same side; and so, indirectly, with all the corresponding half of the cord, except the small posterior median column: for fibres connect it with the anterior pyramid, with the lateral tract or column, and with the restiform body.

Corpus dentatum. The *dentate body* (corpus dentatum) is contained in the white fibres of the cerebellum, and resembles in structure Situation and that in the corpus olivare of the medulla oblongata. This body measures three fourths of an inch from before backwards, and is situate near the inner part of the white centre. structure. It consists of a small capsule which, when cut across, appears as a thin, wavy, grayish-yellow line; this bag is open at the anterior part, and encloses a nucleus of whitish matter. Through its anterior aperture issues a band of fibres from the nucleus to join the superior peduncle.

Dissection. *Dissection.*—One other section must be made to show the fourth ventricle and the structure of the vermiform process. Let the knife be carried vertically through the centre of the vermiform process (the cerebellum still resting on its under surface), and then, on separating the halves of the cere-

bellum, the structure of the central uniting part, as well as the boundaries of the fourth ventricle, may be observed.

Structure of the vermiform process.—The vermiform processes (upper and lower) of the cerebellum are united in one central part; and this connects together the hemispheres. Internally, the structure of this connecting piece is the same as that of the rest of the cerebellum, viz. a central white portion with lateral offsets for the laminæ. Here the branching appearance of a tree (arbor vitæ) is best seen, in consequence of the central parts being longer, and the laminæ more divided. Vermiform process is like other parts.

The FOURTH VENTRICLE (fossa rhomboidalis) is a space between the cerebellum and the posterior aspect of the medulla oblongata and pons. It has the form of a lozenge, with the points placed upwards and downwards. The upper angle reaches as high as the upper border of the pons; and the lower, to a level with the inferior part of the olivary body. Its greatest breadth is at the spot where the peduncular offsets of the cerebellum are connected with the medulla and pons; and a transverse line in this situation would divide the hollow into two triangular portions—upper and lower. The lower half has been named the *calamus scriptorius*, from its resemblance to a writing pen. Fourth ventricle. Form and extent, breadth, calamus scriptorius.

The lateral boundaries are more marked at the upper than at the lower part. For about half way down, the cavity is limited on each side by the superior peduncle of the cerebellum, which projects over it, forming part as well of the roof; and along the lower half lies the eminence of the restiform body on each side. Lateral boundary.

The roof of the space is somewhat arched, and is formed above by the valve of Vieussens, and the under part of the vermiform process; and, towards the lower part, by the thin nervous stratum of the ligula (p. 202.), and by the reflection of the pia mater from the spinal cord to the surface of the vermiform process. Roof.

The floor of the ventricle corresponds to the posterior surfaces of the medulla oblongata and pons, and is grayish in colour. Along its centre is a median groove, that ends below, at the point of the calamus and within the swollen part of the posterior pyramid, in a minute hole,—the remains Floor. Parts in it are, median fissure,

fasciculus teres; of the canal of the cord. On each side of the groove is a spindle-shaped elevation, the *fasciculus* s. *eminentia teres.* This eminence reaches the whole length of the floor, and is pointed and little marked inferiorly, where it is covered by gray substance; but it becomes whiter and more prominent superiorly, and its widest point is opposite the attachment of the crus cerebelli. It is formed by the fibres of the medulla oblongata derived from the lateral tract and the restiform body, which ascend to the cerebrum. The outer border of the eminence is limited externally by a slight groove, which (in some bodies well marked) will point out foveæ, the position of two fossæ (fovea anterior et posterior). The posterior, *posterior fossa* is below near the beginning of the groove, anterior; and the *anterior* is opposite the crus cerebelli. At the top of the anterior fossa is a collection of very dark "gray substance" which has a bluish appearance as it is seen through locus cæruleus; the thin stratum covering it, and is named *locus cæruleus**, and a bluish streak (tænia violacea) is continued upwards from it, at the outer edge of the eminentia teres, to the opening in the top of the fourth ventricle. Crossing the floor on each side, opposite the lower border of the pons, white striæ. are some white streaks, that vary much in their arrangement, and sometimes are not to be recognised: they issue from the central median fissure, and enter the crus cerebelli and the auditory nerve (p. 205.); but one may oftentimes be seen to enter the locus cæruleus.

Eminences of nerve nuclei. Besides the objects above mentioned, there are other eminences in the floor of the ventricle, that have been referred to by Stilling as indicating the position of the nuclei of origin of certain nerves.

In lower half; In the lower half of the ventricle—the part called calamus scriptorius, are three somewhat triangular eminences on of ninth, each side for the eighth and ninth nerves:—One of these, viz. that for the ninth nerve, is close to the middle line, and corresponds to the lower pointed part of the fascic. teres. The other two are outside that fasciculus, and are placed in a line one above another, but separated by a well-marked of vagus, groove; the lower of the two is the nucleus of the vagus,

* The term locus cæruleus seems to be applied to the spot, for the dark vesicular matter in it has been named *substantia ferruginea.*

and the upper, that of the *glosso-pharyngeal*. Running into the vagus nucleus below, is the nucleus of the accessory part of the spinal accessory nerve, which begins at the point of the fourth ventricle, close to the middle line, and extends upwards and outwards. glosso-pharyngeal, spinal accessory.

In the upper half of the space some other nerves take their origin from nuclei, but there is only one projection. This is situate over the common nucleus of the sixth and the facial nerve: it is a half globular elevation on the outer part of the eminentia teres, about a line above the white cross striæ on the floor, and close to the lower end of the fovea anterior. In upper half, of the sixth and facial.

The fourth ventricle communicates at the upper part with the third ventricle through the Sylvian aqueduct; and with the subarachnoid space of the cord and brain, through an aperture in the pia mater of the roof that intervenes between the medulla and the cerebellum: laterally, the ventricular space is extended for a short distance between the cerebellum and the side of the medulla oblongata. The lining of the other ventricles is prolonged into this by the aperture of communication with the third. Openings of the ventricle and its lining.

In this ventricle is a vascular fold, or a choroid plexus, on each side, similar to the body of the same name in the other ventricles. It is attached to the inner surface of the membrane (pia mater), that closes the ventricle between the medulla and the cerebellum, and it extends upwards on the side. Its vessels are supplied by the inferior cerebellar artery. Choroid plexus of the cavity.

Gray matter of fourth ventricle.—The gray matter in connection with the floor of the fourth ventricle exists in the form of masses, and as a surface-covering. Gray matter, two kinds.

The special collections, at least those that are to be detected by surface marks, have been already referred to; and those that are deeper placed are described with the origin of the nerves from them. The surface-covering forms a tolerably thick stratum, that is continuous below with the central gray matter of the cord, and extends upwards to the aqueduct of Sylvius. (See also p. 206.) Special deposits, surface stratum.

TABLE OF THE CHIEF ARTERIES OF THE HEAD AND NECK.

Arch of the aorta furnishes to the neck,

- 1. Brachio-cephalic.
  - 1. Common carotid -
    - 1. External carotid -
      - 1. Superior thyroid -
        - Hyoid branch
        - laryngeal
        - thyroid.
      - 2. lingual - - -
        - Hyoid branch
        - dorsal lingual
        - sublingual
        - ranine.
      - 3. facial - - -
        - Inferior palatine branch
        - tonsillitic
        - glandular
        - submental
        - inferior labial
        - coronary -
          - inferior
          - superior
        - lateral nasal
        - angular.
      - 4. occipital - -
        - Meningeal branch
        - posterior cervical.
      - 5. posterior auricular -
        - Stylo-mastoid branch
        - auricular
        - mastoid.
      - 6. ascending pharyngeal -
        - Pharyngeal branches
        - meningeal.
      - 7. temporal - -
        - Auricular
        - parotid
        - articular
        - transverse facial
        - middle temporal
        - anterior temporal
        - posterior temporal.
      - 8. internal maxillary -
        - Inferior dental
        - middle meningeal
        - muscular
        - posterior dental
        - infraorbital
        - spheno-palatine
        - descending palatine
        - vidian
        - pterygo-palatine.
    - 2. internal carotid
      - 1. Arteriæ receptaculi
      - 2. ophthalmic - -
        - Lachrymal
        - supraorbital
        - central of the retina
        - ciliary
        - muscular
        - ethmoidal
        - palpebral
        - frontal
        - nasal.
      - 3. anterior cerebral
      - 4. anterior communicating
      - 5. middle cerebral
      - 6. posterior communicating
      - 7. choroid.
  - 2. subclavian -
    - 1. Vertebral
      - Anterior spinal
      - posterior spinal
      - inferior cerebellar
      - posterior meningeal
      - transverse basilar
      - anterior inferior cerebellar
      - superior cerebellar
      - posterior cerebral.
    - 2. Internal mammary
    - 3. thyroid axis
      - Inferior thyroid - - Ascending cervical.
      - suprascapular - -
        - Supraspinal
        - infraspinal.
      - transverse cervical -
        - Superficial cervical
        - posterior scapular.
    - 4. deep cervical
      - superior intercostal.
- 2. left common carotid.
- 3. left subclavian.

TABLE OF THE CHIEF VEINS OF THE HEAD AND NECK.

Brachio-cephalic is formed by the union of

- Internal jugular
  - 1. Lateral sinus -
    - Superior longitudinal sinus
    - inferior longitudinal sinus
    - straight sinus
    - occipital sinuses
    - ophthalmic vein
    - superior petrosal
    - inferior petrosal.
  - 2. ascending pharyngeal
    - Meningeal branches
    - pharyngeal.
  - 3. lingual -
    - Superficial dorsal
    - lingual
    - ranine.
  - 4. facial -
    - Angular - -
      - Supraorbital
      - frontal
      - palpebral
      - nasal.
    - inferior palpebral
    - dorsal and lateral nasal veins.
    - anterior internal maxillary - - -
      - Alveolar branches
      - infraorbital
      - descending palatine
      - naso-palatine
      - vidian.
    - coronary
      - superior
      - inferior
    - buccal
    - masseteric
    - labial
    - submental
    - inferior palatine
    - tonsillitic
    - glandular.
  - 5. occipital -
    - Mastoid vein
    - cervical.
  - 6. superior thyroid -
    - Thyroid
    - laryngeal.
  - 7. middle thyroid.
- subclavian -
  - 1. Vertebral
    - Spinal
    - deep cervical
    - ascending cervical.
  - 2. external jugular -
    - 1. Internal maxillary -
      - Middle meningeal
      - inferior dental
      - deep temporal
      - pterygoid
      - masseteric.
    - 2. temporal - -
      - Anterior
      - posterior
      - middle temporal
      - parotid
      - anterior auricular
      - transverse facial.
    - 3. posterior auricular -
      - Auricular
      - stylo-mastoid.
    - 4. branch to the internal jugular.
    - 5. suprascapular -
      - Supraspinal
      - infraspinal.
    - 6. transverse cervical -
      - Superficial cervical
      - posterior scapular.
  - 3. anterior jugular.

TABLE OF THE CRANIAL NERVES.

1. First nerve - Filaments to the nose.
2. Second nerve To retina of the eyeball.
3. Third nerve - To muscles of the orbit.
4. Fourth nerve To superior oblique muscle.
5. Fifth or trifacial nerve
   - Ophthalmic
     - Meningeal.
     - lachrymal
       - Lachrymal
       - palpebral.
     - frontal
       - Supraorbital
       - supratrochlear.
     - nasal
       - To lent. ganglion
       - ciliary nerves
       - infratrochlear
       - nasal.
   - ophthalmic or lenticular ganglion
     - Connecting branches
       - To nasal nerve
       - to the third nerve
       - to sympathetic.
     - Ciliary nerves.
   - Superior maxillary
     - Orbital branch
       - Malar
       - temporal.
     - to Meckel's ganglion
     - posterior dental
     - anterior dental
     - infraorbital.
   - Meckel's ganglion
     - Internal branches
       - Nasal
       - naso-palatine.
     - ascending - To the orbit.
     - descending
       - Anterior palatine
       - posterior
       - external.
     - posterior
       - Vidian
       - pharyngeal.
   - Inferior maxillary
     - Small or muscular part
       - deep temporal
       - masseteric
       - buccal
       - pterygoid.
     - large or sensory part
       - Auriculo-temporal
         - Articular, and to meatus
         - parotid
         - auricular
         - temporal.
       - gustatory
         - To submaxillary and sublingual ganglia
         - to hypoglossal
         - to the tongue.
       - inferior dental
         - Mylo-hyoid
         - labial
         - incisor.
   - Otic ganglion
     - Connecting branches
       - To Jacobson's nerve
       - to the fifth and sympathetic.
     - Branches for muscles.
   - Submaxillary ganglion
     - Connecting branches
       - To the gustatory, chorda tympani, and sympathetic.
     - branches to the gland and the mucous membrane of the mouth.

TABLE OF THE CRANIAL NERVES — *continued.*

6. Sixth nerve - To external rectus.

7. Seventh nerve
   - Portio dura -
     - Connecting branches -
       - To join auditory
       - to Meckel's ganglion
       - tympanic and sympathetic nerves
       - the chorda tympani.
     - Branches for distribution -
       - Posterior auricular
       - digastric branch
       - stylo-hyoid branch
       - temporo-facial -
         - Temporal
         - malar
         - infraorbital.
       - cervico-facial -
         - Buccal
         - supramaxillary
         - inframaxillary.
   - portio mollis - - -
     - To the portio dura
     - nerve to cochlea.
     - nerve to vestibule
       - To the common sac
       - to the saccule
       - to the semicircular canals.

8. Eighth nerve
   - Glosso-pharyngeal -
     - Connecting branches -
       - To vagus
       - to sympathetic
       - Jacobson's nerve -
         - Joins otic ganglion,
         - supplies tympanum.
     - Branches for distribution -
       - To carotid artery
       - to the pharynx
       - tonsillitic branches
       - muscular
       - lingual.
   - pneumo-gastric -
     - Connecting branches -
       - To glosso-pharyngeal
       - sympathetic and auricular nerves
       - to the hypoglossal.
     - Branches for distribution -
       - Pharyngeal nerve.
       - superior laryngeal -
         - External laryngeal
         - ascending, descending
           - to the mucous membrane
         - to join the inferior laryngeal.
       - cardiac nerves
       - inferior laryngeal -
         - Cardiac
         - œsophageal, tracheal
         - to constrictor and muscles of larynx
         - to join superior laryngeal.
   - spinal accessory -
     - Connecting branches -
       - To pneumo-gastric
       - to the cervical plexus.
     - Branches for distribution -
       - To sterno-mastoideus and trapezius.

9. Ninth or hypoglossal nerve - -
   - Connecting branches - -
     - To the pneumo-gastric nerve
     - to the sympathetic
     - to loop of atlas
     - to gustatory nerve.
   - Branches for distribution - -
     - Descendens noni
     - thyro-hyoid nerve
     - to the lingual muscles and tongue.

TABLE OF THE SPINAL AND SYMPATHETIC NERVES OF THE HEAD AND NECK.

Spinal Nerves.

- The cervical spinal nerves divide into
  - Anterior branches -
    - The first four form the CERVICAL PLEXUS, which gives off - -
      - Superficial ascending
        - Small occipital nerve
        - great auricular
        - superficial cervical.
      - superficial descending
        - Supraacromial
        - supraclavicular
        - suprasternal.
      - deep internal - -
        - To the pneumo-gastric
        - to the hypoglossal
        - to the sympathetic
        - to rectus major muscle
        - to diaphragm
        - nerves to descendens noni.
      - deep external - -
        - To join the spinal accessory
        - to the sterno-mastoideus
        - to the trapezius
        - to the levator anguli scapulæ.
    - The last four and first dorsal form the BRACHIAL PLEXUS, which gives off - - -
      - Branches above the clavicle -
        - The rhomboid nerve
        - to the phrenic nerve
        - suprascapular nerve
        - subclavian branch
        - posterior thoracic or respiratory
        - to the scaleni muscles.
      - branches below -
        - Are dissected with the upper limb.
  - posterior branches -
    - Are distributed to the muscles of the back, and give off cutaneous nerves.

Sympathetic Nerve.

- The sympathetic nerve has in the neck
  - 1. Superior cervical ganglion has - -
    - Ascending branches, which unite in plexuses - -
      - Carotid plexus which gives - - -
        - Branch to tympanic plexus
        - to the vidian
        - to the sixth and fifth cranial nerves.
      - cavernous plexus, which gives branches - -
        - To the third cranial nerve
        - to the fourth cranial nerve
        - to the fifth and lenticular ganglion
        - to the carotid artery and branches.
    - external branches -
      - To join pneumo-gastric and hypoglossal nerves
      - to the spinal nerves.
    - internal branches -
      - Pharyngeal branches
      - superficial cardiac nerve.
    - branches to vessels - Nervi molles.
  - 2. Middle cervical ganglion -
    - External branches - To the spinal nerves.
    - internal - - -
      - Middle cardiac nerve
      - to supply thyroid body and join the external laryngeal.
  - 3. Inferior cervical ganglion -
    - Anterior branches - To the subclavian artery.
    - external - - -
      - To the spinal nerves forming vertebral plexus.
    - internal - - - Inferior cardiac nerve.

CHAPTER III.

DISSECTION OF THE UPPER LIMB.

Section I.

THE WALL OF THE THORAX AND THE AXILLA.

The parts included in this Section, viz. the wall of the chest and the axilla, are to be learnt within a fixed time, in order that the examination of the thorax may be undertaken. Whilst the dissection of the thorax is in progress, the student will have to discontinue his labours on the upper limb; but, on the completion of that cavity, he must be ready to begin the part of the back that may belong to him. Direction for the dissection.

Position.— Whilst the body lies on the back, the thorax is to be raised to a convenient height by a block, and the arm, being slightly rotated outwards, is to be placed at a right angle to the trunk of the body. Position of body.

Directions.— Before the dissection is begun, attention should be given by the student to the chief depressions on the surface, to the prominences of muscles, and to the projections of the bones; because these serve as guides to the position of objects beneath the skin.

Surface-marking.—Between the arm and the chest is the hollow of the arm-pit, in which the large vessels and nerves of the limb are lodged. The extent of this hollow may be seen to vary much with the position of the limb to the trunk; for in proportion as the arm is elevated, the fore and hinder boundaries are carried upwards, and rendered tense, and the depth of the space is diminished. In this spot the skin is of a dark colour, and is furnished with hairs, and large sweat glands. If the arm is forcibly raised and moved in different directions, whilst the fingers of one hand are placed in the arm-pit, the head of the humerus may be recognised. Marking of surface. Arm-pit.

On the outer side of the limb is the prominence of the Shoulder.

shoulder; and immediately above it is an osseous arch, which is formed internally by the clavicle, and externally by the spine and the acromion process of the scapula. Continued downwards from about the middle of the clavicle, between the pectoral and deltoid muscles, is a slight depression, in which the coracoid process can be felt near that bone. A second groove is sometimes seen extending outwards from the sternal end of the clavicle; this corresponds to the interval between the clavicular and sternal origins of the great pectoral muscle.

Arm. Along the front of the arm is the prominence of the biceps muscle; and on each side of that muscle is a groove, which subsides inferiorly in a depression in front of the elbow joint. The inner of the two grooves is the most marked, and corresponds to the position of the brachial vessels.

Elbow joint. If the elbow joint be semiflexed, the prominences of the outer and inner condyles of the humerus will be rendered evident, especially that on the inner side of the limb. Below the outer condyle, and separated from it by a slight interval, is the projection of the head of the radius, which may be recognised by rotating this bone, the fingers at the same time being placed over it. At the back of the articulation is the prominence of the olecranon.

Dissection to raise the integument. *Dissection.*— The dissection is to be commenced by raising the skin from the side of the chest, and from the arm-pit, so as to lay bare the great pectoral muscle and the hollow of the axilla beneath it. These parts may be denuded by means of the following incisions:—one is to be made along the middle of the sternum (the whole length); another is to be continued along the clavicle for the inner two thirds of the length of that bone, and thence down the front of the arm as low as the fold of the arm-pit. From the xiphoid cartilage two other cuts are to be directed outwards:—one is to extend along the free edge of the anterior fold of the arm-pit, till it is a little below the extremity of the other cut on the arm; and is then to be turned across the inner part of the arm as far as to the posterior fold of the arm-pit. The remaining incision is to pass horizontally outwards over the side of the chest, opposite the xiphoid cartilage, as far back as to a level with the posterior fold of the arm-pit. The two flaps now marked out should be reflected outwards, and be

left attached to the body, in order that they may be afterwards used for the preservation of the part.

The *subcutaneous fascia* of the thorax resembles the same structure in other parts of the body; but in this locality the superficial layer does not contain much fat. **Fasciæ, superficial,**

Beneath the subcutaneous layer is a *deeper* and stronger *special fascia* that closely invests the muscles, and is continuous with the deep fascia of the arm. It is thin on the side of the chest, but becomes much thicker where it is stretched across the axilla. An incision through it, over the arm-pit, will render evident its increased strength in this situation, and its connections with the muscular folds of the axilla which it incases; and if the fore finger be introduced through the opening, some idea will be gained of its capability of confining an abscess in that hollow. **deep.**

Dissection.—The cutaneous nerves of the side of the chest are to be next sought in the fat. Some of these (from the cervical plexus) will be found crossing the clavicle at the middle, and at the inner part; others (anterior cutaneous of the thorax) appear at the side of the sternum,—one from each intercostal space; and others (lateral cutaneous of the thorax) should be looked for along the side of the chest, about one inch below the anterior fold of the axilla, there being one from each intercostal space except the first. As soon as the last mentioned nerves appear through the muscles, they are divided into an anterior and a posterior branch: in the highest two nerves the posterior branches are larger than in the rest; they are to be followed across the arm-pit, and a junction is there to be found with a branch (nerve of Wrisberg) of the brachial plexus. **Dissection of cutaneous nerves of the chest.**

Cutaneous nerves of the cervical plexus.—These cross the clavicle, and are distributed to the integuments over the pectoral muscle. The most internal branch (sternal) lies near the inner end of the bone, and reaches but a short distance below it. Other branches (clavicular), two or more in number, and of larger size, cross the centre of the clavicle, and extend to near the lower border of the pectoralis major; these join one or more of the anterior cutaneous nerves of the thorax. **Descending cutaneous nerves of cervical plexus.**

The *cutaneous nerves of the thorax* are derived from the trunks of the intercostal nerves between the ribs. Of these **Cutaneous branches**

of the intercostal nerves are in two rows. there are two sets: — one, the lateral cutaneous nerves of the thorax, arise from the trunks of the nerves about midway between the spine and the sternum; the other set, the anterior cutaneous nerves of the thorax, are the terminations of the same intercostal trunks at the middle line of the body.

One along middle line. The *anterior cutaneous* nerves, after piercing the pectoral muscle, are directed outwards in the integuments in the form of slender filaments. The offset of the second nerve joins a cutaneous branch of the cervical plexus; and the others supply the mammary gland and the integuments. Small cutaneous branches of the internal mammary vessels are found with these nerves.

The other on side of chest. These have The *lateral cutaneous* nerves come between the digitations of the serratus muscle, and divide immediately into an anterior and a posterior branch. There is not usually any lateral cutaneous nerve to the first intercostal trunk; and that of the second intercostal trunk wants commonly the anterior of the two offsets, into which the other lateral cutaneous nerves bifurcate.

anterior and The *anterior offsets* bend forwards over the pectoral muscle, and end in the mammary gland and the integuments. The lowest also give twigs to the digitations of the external oblique muscle.

posterior branches. The *posterior offsets* are distributed to the integuments over the latissimus dorsi muscle and the back of the scapula. The branch from the second intercostal nerve is larger than the rest, and, perforating the fascia of the axilla, supplies the integument of the arm (p. 280.), from which circumstance it is named *intercosto-humeral.* As it crosses the axilla it is divided into two or more pieces, and is connected to the nerve of Wrisberg by a filament of variable size. The branch of the third intercostal also gives filaments to the armpit and the inner part of the arm.

(One or more of this set reach the arm.)

Office of the breast. The MAMMA, or the breast, is the gland for the secretion of the milk, and is situate on the front of the chest, though somewhat towards the lateral aspect.

Form and position; with its dimensions. The gland is hemispherical in form, and is placed over the great pectoral muscle, but it is rather most prominent at the inner and the lower part. Its dimensions and weight vary greatly. In a breast that is not enlarged by lactation, the mamma measures commonly about four inches across; and extends longitudinally from the third to the sixth or

seventh rib, and transversely from the side of the sternum to the axilla. Its depth is about one inch and a half. The weight of the breast ranges from six to eight ounces. and weight.

Nearly in the centre of the gland (rather to the inner side of the centre) is the conical or cylindrical projection of the nipple or mamilla. This prominence is about half an inch or rather more in length, is slightly turned outwards, and presents in the centre a shallow depression, where it is likewise rather redder. Around the nipple is a coloured ring, —the *areola*, about an inch in width, whose tint is influenced by the complexion of the body; and is altered during the time of menstruation, pregnancy, and lactation. The skin of both the nipple and the areola is provided with numerous papillæ and lubricating glands; and on the surface are some tubercles marking the position of the ducts of those glands. Position and form of the nipple, and the areola. Colour is altered. Skin has glands.

In the male the mammary gland resembles that of the female in general form; for it is prominent though in a much less degree, and it possesses a small nipple, which is surrounded by an areola provided with hairs. The glandular or secretory structure is very imperfect. Breast of the male.

Structure.—In its texture the mamma resembles those compound glands that are formed by the vesicular endings of branched ducts. During lactation the glandular mass is of a reddish white colour. It consists of small vesicles, which are united to form lobules and lobes. Connected with each lobe is an excretory or lactiferous duct; and the whole is surrounded, and bound together by areolar tissue. Structure.

A layer of connective tissue, containing fat, surrounds the gland, and penetrates into the interior, subdividing it into lobes. Some fibrous septa fix the gland to the skin, and support it; these are the ligamenta suspensoria of Sir A. Cooper. In the ultimate structure of the gland, in the nipple, and in the areola, there is not any fatty substance. Investing and fibrous tissue.

Vesicles, lobules, and lobes.—The little vesicles or cells at the ends of the most minute ducts are lenticular or rounded in shape, and when filled with milk or mercury are just visible to the naked eye, being about the size of a small pinhole in paper.—(Cooper.) Each is surrounded externally by a close vascular network. A collection of the vesicles around their duct forms the smallest divisions of the gland, Texture and form of the vesicles. Vesicles form lobules,

and lobules lobes. viz. lobules or glandules, which vary in size from a pin's head to a small tare. By the union of the lobules the lobes are produced, of which there are about twenty altogether, and each is provided with a distinct duct.

Lactiferous ducts; The *ducts* issuing from the several lobes are about twenty in number, and are named from their office *galactophorous* ducts; they converge to the areola, where they swell into oblong dilatations or reservoirs (sacculi) of one-sixth to one-third of an inch in width. Onwards from that spot the ducts become straight, and are continued through the nipple, nearly parallel to one another, and gradually narrowing in size, to open on its summit by apertures varying from the size of a bristle to that of a common pin. Like other excretory ducts, the milk tubes consist of an external or fibrous, and an internal or mucous coat; they are sheathed also by a scaly or pavement epithelium, and in the reservoirs the epithelial lining is said to be columnar. In the nipple the ducts are surrounded by elastic fibrous tissue.

open on end of nipple. Structure.

Small glands of skin. Some of the lubricating *glands* beneath the skin of the nipple and that of the areola are simple sebaceous glands, but others are larger aggregate glands that open in the tubercles before mentioned.

Arteries of the gland *Bloodvessels, nerves, and lymphatics.*—The *arteries* of the breast are supplied by the axillary, internal mammary, and intercostal arteries, and enter both surfaces of the organ. The vessels on the cutaneous surface supply branches to the nipple, which pass from base to apex, being nearly parallel. The *veins*, after issuing from the substance of the breast, are thus disposed:—some form a plexus on the anterior aspect, and a circle around the areola, and end principally in the axillary and internal mammary trunks; but others enter one or more of the intercostal veins, or ascend over the clavicle to join the veins of the neck. In the nipple the veins have an arrangement like that of the arteries. The *nerves* are supplied from the anterior and lateral cutaneous nerves of the thorax, viz. those of the third, fourth, and fifth intercostal nerves. The *lymphatics* pass from either the inner or the outer part of the gland: at the former side they accompany the branches of the internal mammary artery, and open into the anterior mediastinal glands: and on the latter, they reach the axillary glands.

and veins:

in nipple.

Nerves.

Lymphatics.

Dissection of pectoral muscle *Dissection.*—With the arm in the same position with respect to the trunk, the student is first to remove the fascia and the fat from the surface of the great pectoral muscle.

In this proceeding the scalpel should be carried in the direction of the fibres, viz. from the arm to the thorax; and the dissection may be begun at either the upper or lower border of the muscle, according as the one or the other may be the most convenient on the opposite sides of the body.

The fascia and the fat are then to be taken from the arm-pit, but the numerous vessels, nerves, and glands contained in the space, are to be left uninjured. The dissection will be best begun at the outer part, by removing the fascia from the large axillary vessels, where these are about to quit the space and enter the arm. Following upwards those bloodvessels, the student will arrive at the branches that are directed towards the chest, viz. the long thoracic under cover of the anterior boundary, and the circumflex and subscapular vessels and nerves on the posterior boundary of the axilla. Some arterial twigs enter the axillary glands, and a few should be traced out. In taking away the fascia from the posterior boundary of the space, so as to follow the muscles to their insertion into the humerus, a small nerve (internal cutaneous of the musculo-spiral) should be looked for near the great vessels. and the arm-pit.

The large nerves of the brachial plexus are to be defined: with moderate caution they cannot be injured. Nerves.

THE AXILLA.

The axilla, or arm-pit, is the hollow between the arm and the chest. It is somewhat conical in form, and its apex is directed upwards to the root of the neck. The space is larger near the thorax than at the arm, and its boundaries are as follows: — Situation and form of the arm-pit.

Boundaries. — In front and behind the space is limited for the most part by the muscles passing from the trunk of the body to the upper limb; and the folds of the axilla are constructed by the unattached parts of the fleshy strata. Boundaries.

In the anterior boundary are the two pectoral muscles, but these take unequal shares in its construction in consequence of the difference in their shape and size: for the pectoralis major extends over the whole front of the space, reaching from the clavicle to the lower edge of the anterior fold; The pectoral muscles in front,

whilst the pectoralis minor, which is a narrow muscle, corresponds only with the middle part or third of that fold.

and latissimus, teres and subscapularis behind. In the posterior boundary, from above downwards, are the subscapularis, the teres major, and the latissimus dorsi muscles: this boundary reaches lower than the anterior, especially near the humerus, and its lower margin, which is formed mostly by the latissimus dorsi, projects forwards beyond the level of the subscapularis.

Parts at the inner and outer sides. On the inner side of the arm-pit are the first four ribs, with their corresponding intercostal muscles, and the part of the serratus magnus that takes origin from those bones. On the outer side the space has but small dimensions, and is limited by the humerus, and by the biceps and coraco-brachialis muscles.

Situation of the apex The apex of the hollow is situate between the clavicle, the upper margin of the scapula, and the first rib; and the fore finger may be introduced into the space, for the purpose of

and base. ascertaining the depth, and the upper boundaries. The base or widest part of the conically-shaped interval is turned downwards, and is closed by the thick aponeurosis that reaches from the anterior to the posterior fold.

Contents of the space. *Contents of the space.* — In the arm-pit are contained the axillary vessels and the brachial plexus, with their branches; some branches of the intercostal nerves; together with lymphatic glands, and a larger quantity of loose connective tissue and fat. The position of all these, with reference to the boundaries of the space, is to be carefully studied.

Position *Position of the vascular and nervous trunks.* — The large axillary vessels cross the outer portion of the space in passing from the neck to the upper limb. The part of the vessels that can now be seen, lies close to the humerus,

and connections of the axillary vessels. reaching beyond the line of the anterior fold of the arm-pit, and is covered only by the common superficial layers, viz. the skin, the fatty or superficial fascia, and the deep fascia. Behind the vessels are the tendons of the latissimus and teres muscles. On their outer side is the coraco-brachialis muscle. On looking into the arm-pit from below, the axillary vein will be found to lie to the thoracic side of the artery, and to conceal it. After the vein has been drawn aside, the arterial trunk will be seen to lie amongst some of the large nerves of the upper limb, having the median

nerve to the outside; the ulnar, and the small nerve of Wrisberg to the inner side; the internal cutaneous generally in front of, and the musculo-spiral nerve behind it. This part of the artery gives branches to the side of the chest and to the shoulder. The vein likewise receives some branches in this spot.

Position of the branches of the vessels and nerves. — The several branches of the large vessels and nerves have the undermentioned position with respect to the boundaries. Close to the anterior fold, and rather concealed by it, the long thoracic artery extends to the side of the chest; and taking the same direction, though nearer the middle of the arm-pit, are a small artery and vein (external mammary). Extending along the posterior fold, within its lower margin and in contact with the edge of the subscapularis muscle, are the subscapular vessels and nerves; and near the humeral end of the subscapularis the posterior circumflex vessels and nerve bend backwards beneath the large axillary trunks. On the inner boundary, near the upper part, are a few inconsiderable branches of the superior thoracic artery, which ramify on the serratus muscle; but these are commonly so unimportant, that this part of the axillary space may be considered free from vessels in respect of any surgical operation. Lying on the surface of the serratus magnus, is the nerve to that muscle; and perforating the inner boundary of the space, are the lateral cutaneous nerves of the thorax,—two or more offsets of which are directed across the axilla to the arm, and receive the name intercosto-humeral.

Situation of branches of vessels and nerves.

The *lymphatic glands* occupy principally the lower and hinder parts of the axilla, and lie nearer the chest than the arm. Commonly they are ten or twelve in number; but in this particular, as well as in size, they vary much. By their lower ends the glands receive the lymphatic vessels of the arm, of the fore part of the thorax, and of the posterior surface of the back, as well as some of those of the mamma: their efferent ducts unite to form a trunk, which opens into the lymphatic duct of the same side in the neck, or into the subclavian vein by a separate tube. Small vascular twigs from the branches of the axillary vessels are furnished to the glands.

Lymphatic glands of the axilla:

end in the lymphatic duct.

Pectoralis muscle.

The PECTORALIS MAJOR is a triangularly-shaped muscle, which has its base at the thorax and its apex at the arm. It

Origin from chest and clavicle.

arises internally from the front of the sternum, and the cartilages of the true ribs except the last; superiorly from the sternal half of the clavicle; and inferiorly from the aponeurosis of the external oblique muscle of the abdomen. From this wide origin the fibres take different directions,—those from the clavicle being inclined obliquely downwards, and those from the lower ribs upwards, beneath the former; and all end in a

Insertion into the humerus.

tendon, which is *inserted* into the outer edge of the bicipital groove of the humerus for about two inches. This muscle bounds the axilla anteriorly, and is connected sometimes to

Parts covering it,

its fellow by fibres in front of the sternum. Besides the superficial structures and the mamma, the platysma covers the pectoralis major close below the clavicle. A lengthened interval, which corresponds to a depression on the surface,

and along the borders.

separates the clavicular from the sternal attachment. One border (upper) is in contact with the deltoid muscle, and with the cephalic vein and a small artery; and the lower border forms the margin of the anterior fold of the axilla. The parts covered by the muscle will be subsequently seen.

Dissection of the parts beneath pectoralis.

Dissection.—The great pectoral muscle is to be cut across now in the following manner. First, only the clavicular part is to be divided, so that a branch of nerve and artery to the muscle may be found, and a thin membrane around the bloodvessels prepared. By raising the cut part of the muscle, and carefully removing the fat, and a piece of fascia prolonged from the upper border of the small pectoral muscle, the membranous sheath (costo-coracoid), that covers the axillary vessels and nerves, will be seen close to the clavicle; at the same time the cephalic vein will be detected as it crosses inwards to the axillary vein. A branch of nerve (anterior thoracic), and the acromial thoracic artery perforate that tube of membrane, and are to be followed to the pectoral muscles.

Its insertion.

The remaining part of the pectoralis major may be cut about its centre, and the pieces thrown inwards and outwards. Any fat, now coming into view, is to be removed, and the insertion of the tendon of the pectoralis is to be followed to the humerus. The parts beneath the pectoral muscle are now laid bare.

Insertion of the pectoralis. — The tendon of this muscle consists of two parts, anterior and posterior, at its attachment to the bone; the anterior receives the clavicular and upper sternal fibres, and joins the tendon of the deltoid muscle; and the posterior gives attachment to the lower ascending fibres. The tendon is from two inches to two inches and a half wide, and sends upwards one expansion over the bicipital groove to the head of the humerus, another backwards to line the groove, and a third to the fascia of the arm.

Tendon of insertion of pectoralis.

Parts covered by the pectoralis.—The great pectoral muscle covers the pectoralis minor, and forms alone, above and below that muscle, the anterior boundary of the axilla. Between the pectoralis minor and the clavicle it conceals the subclavian muscle, the sheath containing the axillary vessels, and the branches that perforate the sheath. Below the small pectoralis it lies on the side of the chest, on the axillary vessels and nerves, and, near the humerus, on the biceps and coraco-brachialis muscles.

Parts covered by the muscle.

The PECTORALIS MINOR resembles the preceding muscle in shape, and is extended like it from the thorax to the arm. Its *origin* is connected by slips with the front and the upper border of the third, fourth, and fifth ribs, external to their cartilages; and between the ribs, with the aponeurosis covering the intercostal muscles. The fibres converge to their *insertion* into the anterior half of the upper surface of the coracoid process of the scapula. This muscle is placed before the axillary space, and assists the pectoralis major in forming the middle part of the anterior boundary. In that position it conceals the axillary vessels and the accompanying nerves, and two small anterior thoracic nerves. The upper border lies near the clavicle, but between it and that bone is an interval of a somewhat triangular form. The lower border projects beyond the pectoralis major, close to the chest; and along it the long thoracic artery lies. The tendon of insertion is united with that of the short head of the biceps and the coraco-brachialis.

Pectoralis minor arises from chest;

inserted into scapula.

Connections with parts around.

The *costo-coracoid membrane*, or ligament, is a firm membranous band, which receives this name from its insertion on the one side into the rib, and on the other into the coracoid process of the scapula. Between those points of attach-

Costo-coracoid membrane

conceals subclavius, and joins a sheath around vessels. ment it is inserted into the clavicle, enclosing the subclavius muscle, and is joined by the piece of fascia that incases the small pectoral muscle. From its strength and position it gives protection to the vessels surrounded by their loose sheath; and when traced downwards it is found to descend on the axillary vessels and nerves, joining externally the fascia on the coraco-brachialis muscle, and blending below with the sheath on those trunks beneath the small pectoral muscle: its extent is not so great on the inner as on the outer side, for internally it reaches but a very short distance on the axillary vein.

Sheath of vessels. The *sheath* of the axillary vessels and nerves is derived from the deep fascia of the neck, being prolonged from that on the scaleni muscles, and resembles, in its form and office, the funnel-shaped tube of membrane that surrounds the femoral vessels in the upper part of the thigh. It is strongest near the subclavius muscle, where the costo-coracoid band is placed; and it receives below an accession from that same membrane. The anterior part of the tube is perforated by the acromial thoracic artery and the anterior thoracic nerve.

Dissection of costo-coracoid fascia. *Dissection.* — The tube of fascia around the vessels will be demonstrated by making a transverse cut in the costo-coracoid membrane near the clavicle, so that the handle of the scalpel can be passed beneath it. By raising the lower border of the subclavius this muscle will be seen to be incased by fascia, which is attached to the bone both before and behind.

Clean vessels. After the costo-coracoid membrane has been examined, the remains of it are to be taken away; and the upper part of the axillary vessels and nerves, with their branches, should be carefully cleaned.

Subclavius muscle The SUBCLAVIUS MUSCLE is thin and roundish in form, and is placed between the clavicle and the first rib. It *arises* by a tendon from the first rib, at the junction of the osseous and cartilaginous parts, and in front of the costo-clavicular ligament. The fibres ascend obliquely, and are *inserted* into a groove on the under surface of the clavicle, which reaches between the two tubercles (internal and external) for the attachment of the costo and coraco-clavicular ligaments. The muscle overhangs the large ves-

s attached to clavicle and first rib.

sels and nerves of the limb, and is enclosed, as before said, in a sheath of fascia.

The AXILLARY ARTERY is the continuation onwards of the subclavian trunk through the axilla to the upper limb; and the part of the vessel, to which this name is applied, extends from the lower border of the first rib to the lower border of the teres major muscle. In its course through the axillary space, its direction will depend upon the position of the limb to the trunk; for when the arm lies by the side of the body the vessel is curved, its convexity being upwards; and in proportion as the limb is removed to a right angle with the chest the artery becomes straight. In the upper part of the axilla the vessel is deeply placed, but it becomes superficial as it approaches the arm. Its connections with surrounding parts are numerous; and the description of these will be methodised by dividing the artery into three parts — one above, one beneath, and one below the small pectoral muscle. Axillary artery is, arched in the axilla. Has following connections: —

a. Above the small pectoral muscle the artery is contained in the axillary sheath of membrane; on its thoracic side is the axillary vein, and on its acromial side lies the brachial plexus, but the cords of the nerves are separated from it by a slight interval. In this part the cephalic vein crosses it, and it is covered by the clavicular portion of the great pectoral muscle. Behind it are the intercostal muscles of the first space and the first digitation of the serratus magnus muscle, together with a small nerve, the external respiratory. above small pectoral muscle,

b. Beneath the pectoralis the artery is surrounded by the large nervous cords of the plexus, and is thus separated from the vein which is still to the inner side, and from the surrounding muscles. Superficial to the vessel is the pectoralis minor, with part of the pectoralis major; but there is not any muscle immediately in contact with it behind, for the artery is now placed at the top of the axillary space, particularly when the limb is in the position required by the dissection. beneath that muscle,

c. Beyond the pectoralis minor the artery is concealed in part by the lower border of the great pectoral muscle, but thence to its termination, it is covered only by the integuments and the fascia. Beneath it will be the lower part and beyond it.

of the subscapularis muscle, and the tendons of the latissimus and teres. To the outer side is the coraco-brachialis muscle. Here the artery lies in the midst of the large trunks of nerves into which the plexus has been resolved:—Thus on the outer side is the median nerve, with the external cutaneous for a short distance; on the inner side are the ulnar and sometimes the internal cutaneous, with the nerve of Wrisberg; and behind are the musculo-spiral and circumflex nerves, the latter extending only as far as the border of the subscapular muscle. The axillary vein remains as above on the thoracic side of the artery.

Position of nerves

and vein to it.

Branches are supplied to the thorax

The *branches* of the axillary artery are furnished to the wall of the thorax and to the shoulder. The thoracic branches are four in number; two of these (superior and acromial thoracic) arise from the artery above the pectoralis minor, one (alar thoracic) beneath the muscle, and one (long thoracic) at the lower border. Three branches are supplied to the shoulder, viz. one subscapular and two circumflex; the first springs opposite the edge of the muscle of the same name, and the others wind round the neck of the humerus.

and the shoulder.

Upper thoracic.

1. The *superior thoracic* branch is the highest offset of the artery, and arises opposite the first intercostal space; it is a small vessel, and ramifies on the side of the chest, where it anastomoses with the intercostal arteries.

Acromial thoracic is large,

and supplies thorax and shoulder.

2. The *acromial thoracic* branch is a short trunk on the front of the artery, which appears at the upper border of the pectoralis minor, and opposite the interval between the large pectoral and deltoid muscles. Its branches are directed inwards to the two pectoral, and outwards to the deltoid muscle. The inner or thoracic set, besides supplying the thoracic muscles, give a few offsets to the side of the chest, which anastomose with the intercostal and other thoracic arteries. The outer or acromial set end mostly in the deltoid; but one small artery which is derived from them accompanies the cephalic vein for a short distance; and another (*inferior acromial*) perforates the deltoid muscle, and anastomoses on the acromion process with a branch of the suprascapular artery of the neck. One or two small twigs ascend from the trunk of the artery to the subclavius and deltoid muscles.

Inferior acromial offset.

Alar thoracic very irregular.

3. The *alar thoracic* is very inconstant as a separate branch, and its place is mostly supplied by offsets of the subscapular or long thoracic arteries; it is distributed to the glands of the axillary space.

4. The *long thoracic* branch (external mammary) is directed along the border of the pectoralis minor to the side of the chest, on which it extends to about the sixth intercostal space; it supplies the pectoral and serratus muscles, and anastomoses, like the other branches, with the intercostal and thoracic arteries. In the female it gives branches to the mammary gland. Long thoracic.

A second external mammary artery is not unfrequently met with, especially in the female; its position is nearer the middle of the axilla with a companion vein. A second artery.

5. The *subscapular* branch courses with a nerve of the same name along the subscapular muscle, as far as the lower angle of the scapula, where it ends in branches for the serratus magnus and the latissimus dorsi and teres muscles. Near its origin the artery sends backwards a considerable branch round the edge of the subscapular muscle: this *dorsal* branch gives an offset, *infrascapular*, to the ventral aspect of the scapula, and then turns to the dorsum of that bone, where it will be afterwards dissected. The subscapular artery is frequently combined at its origin with other branches of the axillary, or with branches of the brachial artery. Subscapular has a dorsal branch, and infrascapular.

6. The *circumflex* branches (anterior and posterior) arise near the border of the subscapular muscle. One turns in front of, and the other behind the humerus. They will be dissected in the examination of the arm. Two circumflex.

The *axillary vein* continues upwards the basilic vein of the arm, and has the same extent and connections as the axillary artery. It lies to the thoracic side of its artery, and receives thoracic and subscapular branches. Opposite the subscapular muscle it is joined, externally, by a large vein, which is formed by the venæ comites of the brachial artery; and near the clavicle the cephalic vein opens into it. Axillary vein, extent and connections. Branches.

Dissection.—In order that the branches of the brachial plexus may be followed out, the pectoralis minor is to be cut through near its insertion into the coracoid process, and to be turned towards the chest, but without injuring the thoracic nerves in contact with it. The axillary vessels are then to be cut across opposite or below the second rib*, and to be drawn down with hooks; and their thoracic branches may be likewise removed. A dense fascia is to be cleared away from the large nerves of the plexus. Dissection of brachial plexus.

The BRACHIAL PLEXUS results from the union of the an- Nerves entering

* The student must be careful not to cut the vessels higher than the spot mentioned, otherwise he will injure the dissection of the neck.

brachial plexus. Its situation terior branches of the first dorsal and the four lower cervical nerves; and for the completion of this plexus, a slip is added from the lowest nerve in the cervical plexus. The interlacement of the nerves giving rise to the plexus, is placed partly in the neck, and partly in the axilla, and divides opposite the coracoid process into large trunks for the supply of the limb. The part of the plexus above the clavicle is described in the dissection of the head and neck (p. 76.). The part below the clavicle has the same con- and connections. nections as the axillary artery with the surrounding muscles, and the nerves are arranged in it in the following manner: —

The nerves form three cords that lie around the artery, At first the plexus consists of two cords, which are placed external to the artery, and are thus constituted; — that nearest the vessel is formed by the last cervical and first dorsal nerves; and the other, by the fifth, sixth, and seventh cervical nerves. A little lower down a third or posterior cord is produced by the union of two fasciculi, which are derived, one from each of the others; so that, beneath the small pectoral muscle, the plexus consists of three large cords, one being to the outer side, one to the inner side, and one behind the vessel. Occasionally there may be some deviation from this mode of arrangement.

and give these several branches, viz. The *branches* of the plexus below the clavicle are furnished to the muscles of the front of the chest; to some of the muscles of the scapula, and the latissimus dorsi; and to the arm. They arise from the several cords in the following way: —

from the outer, The *outer cord* gives origin to one anterior thoracic branch, to the musculo-cutaneous trunk, and to the outer head of the median nerve.

inner, and The *inner cord* produces a second anterior thoracic nerve, the inner head of the median, the internal cutaneous, the nerve of Wrisberg, and the ulnar nerve.

posterior cord. The *posterior cord* furnishes the subscapular branches, and ends in the circumflex and musculo-spiral nerves.

The following are seen, viz. Only the thoracic and subscapular nerves are now dissected to their termination; the remaining nerves will be seen in the arm.

two anterior thoracic, The *anterior thoracic* branches are two in number, — outer and inner with respect to the cords of the plexus.

outer *a.* The *outer* nerve crosses inwards, over the axillary ar-

tery, to the under surface of the great pectoral muscle in which it ends. On the inner side of the vessel it communicates with the following branch. *b.* The *inner thoracic* branch turns upwards between the artery and vein, and, after receiving the offset from the other, divides into many branches that enter the under surface of the pectoralis minor. Some twigs enter the great pectoral muscle, after passing either through or above the border of the pectoralis minor. and inner.

The *subscapular nerves* are three in number. Two enter the subscapular muscle, and are named upper and lower from their relative position; and the third is the long subscapular. Three subscapular;

a. The *upper* branch is the smallest, and enters the highest part of the subscapularis muscle. *b.* The *lower subscapular* branch (nerve of the teres muscle) gives an offset to the inferior part of the subscapular muscle, and ends in the teres major. *c.* The *long subscapular* nerve takes the course of the artery of the same name along the posterior wall of the axilla, and ends in the latissimus dorsi muscle. upper, lower, and long subscapular

Another small nerve, *posterior thoracic* (nerve to the serratus, external respiratory, Bell) is now seen on the surface of the serratus muscle. It arises above the clavicle (p. 77.), from the fifth and sixth cervical nerves; — to reach its destination, it descends behind the axillary artery, and enters the surface of the serratus magnus muscle which is towards the axilla. Posterior thoracic.

The LATISSIMUS DORSI MUSCLE may be now examined as far as it enters into the posterior fold of the axilla. Arising from the back of the trunk of the body, and crossing the lower angle of the scapula, the muscle ascends to be *inserted* by a tendon into the bottom of the bicipital groove. At its attachment to the bone, the tendon is about one inch and a half in depth, and is in front of that of the teres; at its lower border aponeurotic fibres connect it with the teres, but a well marked bursa intervenes between the two near the bone. The fibres have a cross arrangement in their course to the tendon of insertion; for whilst those that are attached to the lower ribs ascend to the upper edge of the tendon, those from the spines of the dorsal vertebræ descend to the lower edge. Thus the fibres produce a hollow or groove, which Latissimus in the fold of the axilla. Disposition of its fibres.

lodges the lower border of the scapula and the teres major muscle.

Dissection of the serratus.

Dissection.—To lay bare the serratus muscle, which passes from the chest to the base of the scapula, the arm must be drawn from the trunk, so as to separate the scapula from the thorax. The nerves of the brachial plexus should then be cut through opposite or below the second rib, and the fat and the connective tissue should be cleaned from the surface of the muscle.

Serratus muscle is attached to the ribs and scapula,

The SERRATUS MAGNUS MUSCLE extends between the base of the scapula and the thorax. It *arises* from the outer surface and the lower border of the eight upper ribs, about two inches from their cartilages, by pointed processes, which are nine in number in consequence of the second rib having two. The fibres converge towards the base and the angles of the scapula, but from a difference in their direction, the muscle appears to consist of three parts. The *upper* part is attached internally to the first two ribs and to an aponeurotic arch between them; and externally, to an impression on the ventral surface of the upper angle of the scapula. A *middle* part, which is very thin, extends from the next two ribs (third and fourth) to the base of the shoulder bone. And a *lower* part, which is the strongest, is connected on the one side with four ribs (fifth, sixth, seventh, and eighth), where it digitates with like processes of origin of the external oblique muscle; and, on the other side, it is fixed into the rough surface of bone on the costal aspect of the lower angle of the scapula. The muscle is applied against the ribs and the intercostal muscles, and is partly concealed by the pectoral muscles and the axillary vessels and nerves: in the ordinary position of the arm, the scapula and the subscapularis muscle are in contact with it.

and its fibres seem to form three parts.

Connections of the muscle.

Dissection of the intercostal muscles.

Dissection.—The intercostal muscles will be brought into view by detaching the processes of origin of the serratus from the ribs, and taking away the loose tissue on the surface. Towards the front of the chest the thin aponeurosis, that is continued forwards from the external fleshy stratum to the sternum, is to be retained. Some of the lateral cutaneous nerves should be preserved.

Intercostal muscles

The INTERCOSTAL MUSCLES are named from their position between the ribs. There are two layers in each space; but

neither stratum occupies the whole length of a space, for one (the external) ceases in front at the costal cartilages, and the other (internal) extends backwards only to the angle of the ribs. Their number, and their depth and size are determined by the intercostal spaces. And the direction of the fibres differs in each stratum; for, whilst those of the external muscle pass very obliquely downwards and forwards, those of the internal layer have an opposite though less oblique direction, so that the fibres cross. are two layers in each space.

The *external muscle* is fixed to the outer margin of the ribs of the corresponding space, and consists of fleshy and tendinous fibres. Posteriorly the fibres begin at or near the tubercle of the rib, and anteriorly they end short of the middle line, but after a different manner in the upper and lower spaces. In the intervals corresponding to the true ribs, they cease near the cartilages, and a thin aponeurosis is continued onwards from the point of ending to the sternum. In the lower spaces, the muscles are continued between the cartilages (Theile), and in the last two they reach the ends of the ribs. Outer layer is deficient anteriorly; difference above and below,

Dissection.— The internal intercostal muscle will be seen by cutting through and removing the external layer in one of the spaces, as for instance the second, where it is widest; the muscle will be recognised by the difference in the direction of the fibres. Dissection of deeper muscle,

Far back between the two muscles, and close to the rib above, the intercostal nerve and artery will be found. A branch of the nerve to the surface (lateral cutaneous of the thorax) should be followed through the external muscular layer; and the trunk of the nerve is to be traced forwards in one or more spaces to the sternum and the surface of the thorax. The hinder part of these muscles will be seen in the dissection of the back, and of the thorax. of nerves and vessels.

The *internal intercostal* muscle is attached to the inner border of the ribs bounding the intercostal space. It begins in front at the anterior part of the space, and ceases behind near the angle of the ribs. Behind, the muscles do not end at the same distance from the spine, for the upper and lower approach nearer than the middle set; and, in front, in the two lowest spaces, the muscular fibres are continuous with those of the internal oblique of the abdomen. One surface Inner layer of the muscles deficient posteriorly; joins internal oblique below.

is covered by the external muscle and by the intercostal vessels and nerve; and the opposite surface is in contact with the pleura.

Dissection of internal mammary vessels.

Dissection.— To bring into view the triangularis sterni muscle and the internal mammary vessels, the cartilage of each true rib, except the first and seventh, is to be taken away on the right side of the body*; but the two ribs mentioned are to be left untouched for the benefit of the dissectors of the abdomen and the head and neck. Small arteries to each intercostal space and the surface of the thorax, as well as the intercostal nerves, are to be preserved. The surface of the triangularis sterni will be made apparent, after the removal of the cartilages, by cleaning the loose tissue and fat from it.

Triangularis sterni

The TRIANGULARIS STERNI is a thin muscle, which is placed inside the cavity of the thorax, and beneath the costal cartilages. It *arises* internally from the side of the xiphoid cartilage, from the side of the sternum as high as the third cartilage, and from the three or four lower sternal costal cartilages. Its fibres are directed outwards, the upper being most oblique, and are *inserted* by fleshy fasciculi into all the true ribs except the last two and the first, at the junction of the bone and cartilage, and into the aponeurosis in the intercostal spaces. The muscle is covered by the ribs and the internal intercostal muscles, and by the internal mammary vessels and the intercostal nerves. It lies on the pleura; its lower fibres are continuous with those of the transversalis abdominis.

is in the thorax and attached to the ribs.

Connections.

Internal mammary is a branch of subclavian;

The *internal mammary artery* is a branch of the subclavian (p. 74.), and enters the thorax beneath the cartilage of the first rib. It is continued through the thorax, lying beneath the costal cartilages and about half an inch from the sternum, as far as the interval between the sixth and seventh ribs; here it gives externally a large muscular branch (musculo-phrenic), and then passing beneath the seventh rib, enters the sheath of the rectus muscle of the wall of the abdomen. In this course in the chest the artery lies on the pleura and the triangularis sterni, and is crossed by the

courses through thorax to abdomen.

* On the left side the vessels and the muscle will have been destroyed by the injection of the body.

intercostal nerves. It is accompanied by two veins, and by a chain of lymphatic glands. The following *branches* take origin in the thorax:— Branches

a. A small branch (*comes nervi phrenici*) arises as soon as the artery enters the chest, and descends to the diaphragm along the phrenic nerve. to phrenic nerve,

b. A few small *mediastinal* branches are distributed to the remains of the thymus gland, the pericardium, and the triangularis sterni muscle. mediastinal,

c. Two *anterior intercostal branches* turn outwards in each space, one being placed on the border of each costal cartilage, and terminate by anastomosing with the aortic intercostal arteries. intercostal, and

d. Perforating branches, one or two for each space, pierce the internal intercostal and pectoral muscles, and are distributed on the surface of the thorax with the anterior cutaneous nerves. The lower branches supply the mamma in the female. perforating branches.

e. The *musculo-phrenic* branch courses outwards beneath the cartilages of the seventh and eighth ribs, and enters the wall of the abdomen by perforating the diaphragm. It supplies anterior branches to the lower intercostal spaces, and its termination will be seen in the dissection of the abdominal wall. Musculo-phrenic branch.

Two *veins* accompany the artery; these join into one trunk, which opens into the innominate vein. Veins.

The *intercostal nerves* supply the wall of the thorax, and are seen now in the anterior part of their extent. They are the anterior trunks of the dorsal nerves, and are placed at first between the layers of the intercostal muscles. About midway between the spine and the sternum, each gives off the lateral cutaneous nerve of the thorax: diminished in size by the emission of that offset, the trunk is continued onwards, at first in, and afterwards beneath the internal intercostal muscle, as far as the side of the sternum, where it ends as the anterior cutaneous nerve of the thorax. The intercostal nerves supply branches to the intercostal muscles, and to the triangularis sterni. Intercostal nerves; course, termination, and branches.

The *aortic intercostal arteries* furnish branches to the thoracic wall; they lie with the nerves between the strata of intercostal muscles, and nearer the upper than the lower rib bounding the intercostal space. About the mid point (from before back) of the space the artery bifurcates:—one branch follows the line of the upper rib, and the other descends to the lower rib; both anastomose anteriorly with the intercostal Intercostal arteries are with the nerves, and branch into two.

branches of the internal mammary artery. A small cutaneous offset is distributed with the lateral cutaneous nerve of the thorax.

At this stage the thorax and back are dissected.

The dissector of the upper limb now waits the appointed time for the examination of the thorax. But as soon as the body is turned for the dissection of the back, he is to proceed with the parts marked for him in Chapter V. p. 404. After the back is finished, the limb is to be detached from the trunk by sawing the clavicle about the middle, and cutting through the soft parts connected with the scapula.

Section II.

SCAPULAR MUSCLES, VESSELS, NERVES, AND LIGAMENTS.

Position.

Position.— After the limb has been separated from the trunk, it is to be placed with the subscapularis uppermost.

Dissection of muscles.

Dissection.— The different muscles that have been traced to the scapula in the dissection of the front of the thorax and the back, are now to be cleaned, and followed to their insertion into the bone. A small part of each, about an inch in length, should be left for the purpose of ascertaining more exactly the osseous attachment.

Muscles inserted

The borders and the angles of the scapula have the following muscles connected with them:—

into the margins of the scapula;

The *upper margin* of the scapula has but one muscle, the omo-hyoid, attached to it. At its origin that muscle is about half an inch wide, and is connected to the edge of the bone behind the notch, but sometimes to the ligament (posterior special) which converts the notch into a foramen. The *lower margin*, or costa, gives origin to the long head of the triceps, and to some fibres of the teres major; but these attachments to the bone will be ascertained in the progress of the dissection.

into the base;

The *base* of the bone has many muscles inserted into it. Between the superior angle and the spine, the levator anguli scapulæ is inserted. Opposite the spine, the rhomboideus minor is fixed; and between the spine and the inferior angle the rhomboideus major is attached: the upper fibres of the last muscle often end in an aponeurotic arch, and

are connected indirectly to the bone by means of an expansion from it. Internal to these muscles, and inserted into the whole extent of the base of the scapula, is the serratus magnus muscle.

On the *angles* of the scapula the fibres of the serratus magnus are collected in this way: the highest fibres are fixed to the under surface of the upper angle, and the lower fibres are inserted into an impression on the corresponding aspect of the lower angle. On the outer surface of the inferior angle lies the teres major, which will be subsequently seen. into the angles of the bone;

The insertion of the small pectoral muscle into the front of the upper part of the *coracoid process* may be now ascertained. into coracoid process.

Dissection.—By the separation of the serratus from the subscapularis a thin fascia comes into view, that belongs to the last muscle, and is fixed to the bone around its margins. After the fascia has been observed, it may be removed; and the muscle is then to be followed forwards to its insertion into the humerus. Next, the axillary vessels and nerves, and the offsets of these to the muscles, should be nicely cleaned. Dissection.

The SUBSCAPULARIS MUSCLE occupies the under surface of the scapula, and is concealed by that bone, when the limb is in its natural position. The muscle *arises* from all the concave surface on the ventral aspect of the scapula, except the neck and the angles, and is connected to the ridges of the bone by tendinous processes. It is *inserted* by a tendon into the small tuberosity of the humerus, and by fleshy fibres into the neck of the bone for nearly an inch below that process. By one surface the muscle bounds the axilla, and is in contact with the axillary vessels and nerves and the serratus magnus. By the other, it rests against the scapula and the shoulder joint; and between its tendon and the root of the coracoid process is a bursa, which generally communicates with the synovial membrane of the shoulder joint. The lower border projects much beyond the bone: it is contiguous to the teres major, and comes into contact with the latissimus dorsi and the long head of the triceps: along this border is the subscapular artery, which here gives backwards its dorsal branch. Subscapularis fills the hollow of scapula; is inserted into humerus. Connections.

Dissection.

Dissection.— The subscapular muscle is to be next separated from the bone; and at the same time its tendinous processes of origin, the connection between its tendon of insertion and the capsule of the shoulder joint, as well as the bursa, are to be observed. A small arterial anastomosis on the ventral surface of the bone is likewise to be dissected out.

Small infra-scapular artery.

The *infrascapular artery* ramifies on the ventral surface of the scapula, and is an offset of the dorsal branch of the subscapular vessel (p. 261.). It enters beneath the subscapularis muscle, and forms an anastomosis with small twigs of the supra and posterior scapular branches.

Position for the shoulder.

Position.— The examination of the muscles on the opposite surface of the scapula may be next undertaken. For this purpose the scapula is to be turned over, and a block, which is of sufficient height to allow the shoulder to be made prominent, is to be placed between it and the arm.

Dissection of the shoulder.

Dissection.— The skin is to be removed from the prominence of the shoulder, by beginning in front at the anterior border of the deltoid muscle. Some small cutaneous nerves are to be found in the fat: some of these descend from above, over the acromion, and others come to the surface about half way down the posterior border of the deltoid muscle.

Cutaneous nerves of the shoulder.

Superficial nerves.—Branches of nerves, *supra-acromial*, descend to the surface of the shoulder from the cervical plexus (p. 60.). A *cutaneous branch* of the circumflex nerve turns forward from beneath the posterior border of the deltoid, and supplies the integument covering the lower two thirds of that muscle.

Dissection of deltoid muscle.

Dissection.— The fat and fascia are now to be taken from the deltoid muscle, its fibres being made tense at the same time. Beginning at the anterior edge of the muscle, the dissector is to carry the knife upwards and downwards in the direction of the fibres, in order that its coarse, rough, muscular fasciculi may be more easily cleaned. At the same time the fascia may be removed from the back of the scapula, so as to denude the teres major and a part of the infraspinatus muscle.

Deltoid muscle.

The DELTOID MUSCLE is triangular in form, and has its base at the scapula and clavicle, and its apex at the humerus.

It *arises* from nearly all the lower edge of the spine of the scapula, from the anterior border of the acromion, and from the outer half or third of the clavicle. Its fibres converge to a tendon, and are *inserted* by means of it into a triangular impression, above the middle of the outer surface of the humerus, which is three inches long, and three quarters wide above. The anterior border is contiguous to the pectoralis major muscle and the cephalic vein; and the posterior rests on the infraspinatus and triceps muscles. The origin of the muscle corresponds to the attachment of the trapezius to the bones of the shoulder; the insertion is united with the tendon of the pectoralis major, and has a fasciculus of the brachialis anticus on each side of it.

Origin.

Insertion.

Adjacent parts.

Dissection. — The deltoid is to be divided near its origin, and thrown down as much as the circumflex vessels and nerve will permit. As the muscle is raised a large thick bursa between it and the head of the humerus comes into sight. The loose tissue and fat are to be taken away from the circumflex vessels and nerve, and the remains of the bursa are to be removed. The insertion of the muscle should be also examined.

Dissection to detach deltoid.

Parts covered by deltoid. — The deltoid conceals the head and the upper part of the humerus, and those parts of the dorsal scapular muscles that are fixed to the great tuberosity of the bone. Below the head of the bone are the circumflex vessels and nerve, and the upper part of the biceps muscle; and in front of the humerus is the coracoid process with its muscles. A large bursa, sometimes divided into small sacs, intervenes between the convex end of the bone, and the under surfaces of the deltoid muscle and the acromion process.

Parts covered by the deltoid.

Dissection. —By following back the circumflex vessels and nerve through a space between the humerus and the long head of the triceps, their origin from the axillary trunks will be arrived at. In taking the fat from that space care must be taken of a branch of nerve to the teres minor muscle. Arching backwards, in front of the neck of the humerus, is the small anterior circumflex artery.

Dissection of circumflex vessels.

The *circumflex arteries* are the last branches of the axillary trunk, and arise near its termination (p. 261.). They

Two circumflex arteries

are two in number, and are named anterior and posterior from their position on the neck of the humerus.

anterior and

The *anterior* branch is a small artery that courses transversely outwards, beneath the coraco-brachialis and biceps muscles, and anastomoses in front of the humerus with branches of the posterior circumflex. As it crosses the bicipital groove it sends upwards a branch to the articulation and the head of the humerus.

posterior.

The *posterior circumflex* artery is larger in size, and arises opposite the border of the subscapular muscle. It winds backwards through a space between the humerus and the long head of the triceps, and is distributed chiefly to the deltoid muscle, in which it anastomoses with the acromial thoracic artery. Branches are given from it to the head of the humerus and the shoulder joint, and to anastomose with the anterior circumflex artery. It supplies branches likewise to the teres minor, and the long head of the triceps.

One circumflex nerve

The *circumflex nerve*, at its origin (p. 262.), is placed beneath the axillary artery, and leaves the axilla by turning round the border of the subscapular muscle, with the artery of the same name. Behind the neck of the humerus the nerve divides into two parts, that supply the surrounding muscles, the integuments, and the shoulder joint:—

has cutaneous, muscular, and

One branch turns forwards beneath the deltoid nearly to the anterior border, and ends in the muscle, with the exception of one or two cutaneous filaments that pierce the fibres. The other branch gives an offset to the teres minor muscle, which is remarkable in having a gangliform swelling on it, and then becomes cutaneous over the deltoid (p. 270.), after supplying the posterior part of this muscle. Before the circumflex nerve bifurcates it gives an *articular* filament to the under part of the shoulder joint.

articular branches.

Infraspinatus muscle

The INFRASPINATUS MUSCLE occupies the infraspinal part of the scapula, and extends to the head of the humerus. The muscle *arises* from all the infraspinal fossa of the scapula, except at the neck of the bone, and at the inferior border and the lower angle where the teres muscles are attached; it also arises from the lower side of the spinous process, and from the special fascia covering its surface. Its fibres converge to a tendon, which is *inserted* into the middle impression on the great tuberosity of the humerus, and joins with

arises from fossa of that name;

Insertion.

the tendons of the supraspinatus and teres minor muscles. The greater part of the muscle is subcutaneous, and the fibres that arise from the spine of the scapula overlay the others and the tendon: the upper part is concealed by the deltoid, and the lower end, by the latissimus dorsi. The lower border is parallel to the teres minor, with which it is sometimes united. The muscle lies on the scapula and the humero-scapular articulation, but it is separated from the last by a small bursa.

is partly covered by deltoid.

Other connections.

The TERES MINOR is a narrow fleshy slip, which is often inseparably united with the preceding muscle, along whose lower border it lies. It *arises* on the dorsum of the scapula, from a special surface along the two upper thirds of the inferior costa of the bone, and from the investing fascia; and it is *inserted* by a tendon into the lowest of the three marks on the great tuberosity of the humerus, as well as by fleshy fibres into the humerus below that spot — about an inch altogether. This muscle is partly covered by the deltoid; and it rests on the long head of the triceps and the shoulder joint. Underneath it the dorsal branch of the subscapular artery turns.

Teres minor is on back of the scapula.

Insertion with the former.

Parts around it.

The TERES MAJOR muscle is extended from the inferior angle of the scapula to the humerus. Its *origin* is from the rough surface on the dorsum of the scapula at the inferior angle, from the inferior costa of the bone for some distance, and from the fascia covering the teres minor. The fibres end in a tendon which is *inserted* into the inner edge of the bicipital groove of the humerus. This muscle forms part of the posterior fold of the axilla, and is situate beneath the axillary vessels and nerves near the humerus. At its origin it is covered by the latissimus dorsi. The upper border is contiguous to the subscapularis muscle, and the lower is received into a hollow formed by the fibres of the latissimus dorsi. At the humerus the tendon of the muscle is about two inches wide, and lies behind that of the latissimus; above, the two are separated by a bursa; but below they are united, and an expansion is sent from them to the fascia of the arm. A second bursa is behind the tendon between it and the bone.

Teres major reaches from lower angle of scapula to the humerus.

Adjacent muscles.

Tendon and bursæ.

Below the scapula (inferior costa), where the teres muscles separate from one another, is a triangular interval, which is

Two spaces between

the teres and head of the triceps. bounded in front by the shaft of the humerus, and above and below by the teres muscles. This space is divided into two by the long head of the triceps. Through the anterior part,

Anterior and posterior. which is of a quadrilateral shape, the posterior circumflex vessels and the circumflex nerve pass to the outer side of the limb; and through the posterior smaller triangular part, the dorsal branch of the subscapular artery turns to be distributed.

Dissection of ligaments of the clavicle *Dissection.* — In order that the acromion process may be sawn through to expose the supraspinatus muscle, the ligaments of the scapula and clavicle, which would be injured by such a proceeding, should be next dissected. These ligaments will be recognised by removing the connective tissue at the spots specified. One ligament (coraco-clavicular) passes from the coracoid process to the under part of the clavicle. A capsular ligament, connecting the outer end of the clavicle with the acromion, will be seen by taking away

and scapula. the fibres of the trapezius and deltoid muscles. Another strong band (coraco-acromial) passes transversely between the acromion and the coracoid process; and lastly a small fasciculus (posterior proper ligament) is placed over the notch in the superior costa.

Union of the clavicle and scapula. LIGAMENTS OF THE CLAVICLE AND SCAPULA. — The clavicle is connected to the scapula by a distinct joint with the acromion, and by a strong ligament (coraco-clavicular) between it and the coracoid process.

Coraco-clavicular, has a conical The *coraco-clavicular* ligament consists of two parts, each having a different direction and designation. The posterior piece, called *conoid* from its shape, is fixed by its apex to the posterior and inner part of the coracoid process, and by its base to the tubercle and the under surface of the clavicle, at the junction of the outer with the middle third of the bone. The anterior part, *trapezoid ligament,* is external to the

and a square piece. conoid piece: it is connected inferiorly to the inner border of the coracoid process, and superiorly to the line on the under surface of the clavicle, which extends outwards from the tubercle before mentioned. The two parts of the ligament are united posteriorly, but are separated by an interval in front.

Joint with the *Acromio-clavicular articulation.* — The articular surfaces

of the clavicle and acromion process of the scapula are retained in contact by some scattered fibres, which form a kind of capsule for the joint. Some of the fibres are stronger above and below, and are thus considered to constitute a *superior* and an *inferior* ligament. An *interarticular fibro-cartilage* is generally found between the bones only at the upper part of the joint; but sometimes it forms a complete interarticular septum. If the fibro-cartilage is perfect, there are two *synovial membranes ;* if it is imperfect, there is only one present in the joint. The joint should be opened to see the cartilage and the synovial membrane.

acromion, superior and inferior bands, fibro-cartilage, and synovial sac.

The *special ligaments* of the scapula are two in number, anterior and posterior, and extend from one to another part of the bone.

Ligaments of scapula.

The *posterior* ligament is a round fasciculus of fibres stretching across the notch in the upper costa of the scapula. By one end it is attached to the base of the coracoid process, and by the other to the costa behind the notch. It converts the notch into a foramen, through which the suprascapular nerve passes.

Posterior and

The *anterior* ligament is triangular in form, and extends transversely between the acromion and the coracoid process. Externally it is inserted by its point or apex into the tip of the acromion ; and internally, where it is much wider, it is attached to all the outer border of the coracoid process, and extends backwards to the attachment of the capsule of the shoulder joint. This ligament overhangs the shoulder joint; it consists usually of two thickened bands, anterior and posterior, with a thin intervening part.

anterior. This is formed of two pieces.

Dissection.—To lay bare the supraspinatus muscle, the acromion process is to be sawn through, and removed with the outer end of the clavicle. A strong fascia covers the surface of the muscle ; this is to be observed, and then taken away.

Dissection.

The SUPRASPINATUS MUSCLE has the same form as the hollow of the bone that it fills. It *arises* from all the surface of the supraspinal fossa of the scapula, except from the cervical part; from the upper side of the spine of the bone ; and from the fascia covering its surface. Its fibres end in a tendon, that crosses over the shoulder joint, and is *inserted* into the upper impression on the great tuberosity of the

Supraspinatus fills the hollow of that name ; is inserted into hu-

merus. humerus. The muscle is concealed by the trapezius and the acromion process; and it rests upon the scapula, the shoulder joint, and the suprascapular vessels and nerves. Its tendon joins that of the infraspinatus at the attachment to the humerus.

Connections.

Dissection of suprascapular vessels.

Dissection.—The vessels and nerves on the dorsum of the scapula will be traced by separating the supra and infraspinatus muscles from the bone. In the supraspinal fossa are the suprascapular vessels and nerve, which are to be followed beneath the acromion to the infraspinal fossa; and entering the infraspinal fossa, beneath the teres minor muscle, is the dorsal branch of the subscapular artery. The anastomosis between the vessels should be carefully cleaned.

Suprascapular artery

The *suprascapular artery* is derived from the subclavian trunk, and is one of the branches into which the thyroid axis subdivides (p. 74.). After a short course in the neck it crosses over the ligament at the superior costa, and enters beneath the supraspinatus muscle. In that position it furnishes a *supraspinal* branch for the supply of the muscle, the bone, and the shoulder joint; and it ends in the infraspinal fossa, where it gives offsets to the infraspinatus muscle and the scapula, anastomosing with the dorsal branch of the subscapular, and with the posterior scapular artery of the subclavian (p. 74.).

gives a supraspinal branch, and ends in infraspinatus.

Vein.

The companion *vein* of the suprascapular artery joins the external jugular vein.

Suprascapular nerve has muscular branches like artery.

The *suprascapular nerve* is a branch of the brachial plexus (p. 77.). When it reaches the costa of the scapula, it enters the supraspinal fossa beneath the posterior proper ligament. In the fossa it supplies two branches to the supraspinatus; and the nerve is then continued beneath a fibrous band to the infraspinatus muscle, in which it ends. The nerve gives some *articular* filaments to the shoulder joint, and other offsets to the scapula.

and articular.

Dorsal branch of subscapular artery.

The *dorsal branch* of the *subscapular artery* (p. 261.) turns backwards below the inferior costa of the scapula, through the posterior of the two spaces between the teres muscles. Entering the infraspinal fossa beneath the teres minor, it supplies that muscle and the infraspinatus, and anastomoses with the ending of the suprascapular artery. This artery

sends a branch along the dorsum of the scapula, between the teres muscles, towards the inferior angle of the bone, where it anastomoses with the posterior scapular artery.

Section III.

THE FRONT OF THE ARM.

Position.— For the dissection of the anterior part of the arm the limb should lie flat on the table, with the front uppermost. Position

Dissection.— The skin is to be raised from the front of the arm and the front of the elbow joint. To allow of its reflection, make one incision along the centre of the biceps as far as two inches below the elbow; and at its termination, a second cut half round the forearm. The skin should now be stripped from the front and back of the limb, as low as the transverse incision, so that the fat or superficial fascia which contains the cutaneous vessels and nerves may be denuded. Between the skin and the prominence of the olecranon a large bursa may be seen. and incisions in the skin.

The cutaneous veins may be first sought in the fat. These vessels are very numerous below the bend of the elbow, and issue from beneath the integument. One in the centre of the forearm is the median vein, which bifurcates rather below the elbow. External to this is a small vein (radial); and internal to it are the anterior and posterior ulnar veins, coming from the front and back of the forearm. In the arm these veins are united into two; one (basilic) is to be followed along the inner border of the biceps, and the other (cephalic) along the outer side of that muscle. Seek superficial veins.

The cutaneous nerves may be next traced out. On the outer side of the arm, about its middle, are the external cutaneous branches (two in number) of the musculo-spiral; and in the outer bicipital groove, in front of the elbow or rather below it, is the cutaneous part of the musculo-cutaneous nerve. On the inner part of the limb the nerves to the surface are more numerous. Taking the basilic vein as a guide, the internal cutaneous nerve of the forearm will be found by its side, about the middle of the arm; and rather external to this nerve is a small cutaneous offset from it, Trace cutaneous nerves of outer side and inner side of the limb.

which pierces the fascia higher up. Behind the internal cutaneous, in the lower third of the arm, is the small nerve of Wrisberg; and in the upper third at the same aspect, are the small nerves that have been already met with in the dissection of the axilla, viz. the intercosto-humeral, and the internal cutaneous of the musculo-spiral.

Superficial fat. The *superficial fascia* forms a continuous investment for the limb, but it is thicker in front of the elbow than in the other parts of the arm. In that spot it encloses the superficial vessels and lymphatics, and it may be divided into two layers.

The cutaneous veins are CUTANEOUS VEINS.—The position and the connections of the superficial veins in front of the elbow are to be attentively noted by the dissector, because the operation of venesection may be practised in them.

median vein; The *median vein* of the forearm divides into two branches, internal and external, rather below the bend of the elbow; and at its point of division it is joined by an offset from a deep vein. The internal branch (median basilic) crosses to the inner border of the biceps, and unites with the ulnar veins to form the basilic vein of the inner side of the arm. The external branch (median cephalic) is usually longer than the other, and by its junction with the radial vein gives rise to the cephalic vein of the arm.

divides into two branches.

Position and connections of median cephalic, *Branches.*—The *median cephalic* vein is directed obliquely outwards, and lies over the hollow between the biceps and the outer mass of muscles of the forearm. Beneath it is the trunk of the musculo-cutaneous nerve, and over it some small offsets from that nerve are directed. This vein is altogether removed from the brachial artery, and is generally smaller than the median basilic vein. If opened with a lancet, it does not generally yield much blood, in consequence of its position in a hollow between muscles rendering compression of it very uncertain and difficult. The *median basilic* vein is usually more horizontal in direction than the preceding, and crosses the brachial artery as it tends to the inner side of the limb. It is larger than the corresponding vein of the outer side of the arm, and is firmly supported by the fascia beneath, only the aponeurosis of the arm, strengthened by fibres from the tendon of the biceps, intervening between it and the brachial vessels. Branches of

and of the median basilic vein.

the internal cutaneous nerve lie beneath it, and some twigs of the same nerve are placed over it.

The median basilic is the vein on which the operation of bloodletting is commonly practised. It is selected in consequence of its usually larger size and its more superficial position, and the facility with which it may be compressed; but from the close proximity of the vein to the brachial vessels, the spot chosen for the venesection should not be immediately over the trunk of the artery. Venesection is practised in this branch.

The *basilic vein*, commencing near the inner condyle of the humerus in the manner before said, ascends near the inner border of the biceps muscle to the middle of the arm, where it passes beneath the deep fascia and is continuous with the axillary vein. In this course it lies over, or to the inner side of the brachial artery. Basilic vein on inner side of the arm

The *cephalic vein* is derived chiefly from the external branch of the median, for the radial vein is oftentimes very small. It is continued to the shoulder along the outer side of the biceps, and sinks between the deltoid and pectoral muscles, near the clavicle, to open into the axillary vein. Cephalic vein at outer side of the arm

The *superficial lymphatics* of the arm lie for the most part along the basilic vein, and enter into the glands of the axilla. A few lymphatics accompany the cephalic vein, and passing between the pectoral and deltoid muscles, end as the others in the axillary glands. A lymphatic gland is commonly found as low in the limb as the elbow, where it lies in front of the inner condyle of the humerus. Superficial lymphatics.

Cutaneous Nerves.—The superficial nerves of the arm appear on the inner and outer sides, and spread so as to cover the circumference of the limb. All with one exception (intercosto-humeral) are derived from the brachial plexus, either as distinct branches, or as offsets of other nerves. On the outer side of the limb are branches of the musculo-spiral and musculo-cutaneous nerves; on the inner side are two internal cutaneous nerves direct from the plexus (large and small), a third internal cutaneous from the musculo-spiral, together with the intercosto-humeral nerve. The superficial nerves are derived from brachial plexus, except one.

External cutaneous Nerves. — The external cutaneous branches of the *musculo-spiral* nerve are two in number, and appear at the outer side of the limb in the spot before mentioned. The *upper* one turns forwards with the cephalic vein, and reaches Two external cutaneous of musculo-spiral,

to the front of the elbow, supplying the anterior part of the arm. The *lower* pierces the fascia somewhat farther down, viz. about the middle of the outer surface of the arm, and after supplying some cutaneous filaments to that part of the limb, is continued to the forearm.

and one of musculo-cutaneous. The cutaneous part of the *musculo-cutaneous nerve* pierces the fascia in front of the elbow, and at the outer side of the tendon of the biceps muscle. It lies beneath the median cephalic vein, and divides into branches for the forearm.

Two internal cutaneous of brachial plexus. INTERNAL CUTANEOUS NERVES. — The *larger internal cutaneous nerve* perforates the fascia in two parts, or as one trunk that divides almost directly afterwards into two. Its external branch lies beneath the median basilic vein, and is directed to the front of

Large. the forearm; but the internal branch winds to the back of the forearm, over the prominence of the inner condyle of the humerus.

A *cutaneous* offset of this nerve pierces the fascia near the axilla, and reaches as far, or nearly as far as the elbow: it supplies the integuments over the inner part of the biceps muscle.

and small. The *small internal cutaneous nerve* (Wrisberg) appears below the preceding, and extends to the interval between the olecranon and the inner condyle of the humerus, where it ends in filaments over the back of the olecranon. The nerve gives offsets to the posterior surface of the lower third of the arm, and joins, above the elbow, the inner branch of the larger internal cutaneous nerve.

Cutaneous of musculo-spiral. The *internal cutaneous branch* of the musculo-spiral nerve, after it becomes subcutaneous (in the upper third), winds to the back of the arm, and extends nearly as far as the olecranon.

Intercosto-humeral. The *intercosto-humeral branch* of the second intercostal nerve (p. 250.) perforates the fascia near the axilla, and furnishes filaments to the inner side and the posterior surface of the arm, in the upper half. But the size, and even the distribution of the nerve, will depend upon the development and extent of the small internal cutaneous, and the offset of the musculo-spiral nerve.

Deep fascia of the arm The *aponeurosis* of the arm is a white shining membrane that envelops the limb, and sends inwards processes between the muscles. Over the biceps muscle it is thinner than elsewhere. At certain points it receives accessory fibres from the subjacent tendons: — thus in front of the elbow there is an offset from the tendon of the biceps, and near the axilla the tendons of the pectoralis major, latissimus dorsi, and teres, send prolongations to the fascia. At the upper part of the limb the fascia is continuous with that of the axilla, and is prolonged over the deltoid and pectoral muscles

to the scapula and the clavicle. Inferiorly it is continued to the forearm, and is connected to the prominences of bone around the elbow joint, especially to the condyloid ridges of the humerus. Its attachments to those lines of the humerus give rise to the two intermuscular septa of the arm. forms inter-muscular septa.

Directions. — As the back of the arm will not be first dissected, the skin may be replaced on it until the front has been examined. And to keep in place the vessels and nerves at the upper part of the limb, they should be tied together with string, as nearly as may be in their natural position, and then fastened to the coracoid process. Directions to be observed.

Position. — The limb is still to lie on the back, but the upper part is to be raised by means of a small block beneath the scapula, and this bone is to be fixed in such a position as to render tense the muscles. The inner surface of the arm is to be placed towards the dissector. Position of limb.

Dissection. — The aponeurosis is to be reflected from the front of the arm by an incision along the centre, like that through the integuments; and it is to be removed, on the outer side, as far as the line of the humerus leading to the outer condyle, but on the inner side, rather farther back than the corresponding line, so as to bare part of the triceps muscle. In raising the fascia the knife must be carried in the direction of the fibres of the biceps muscle, and care must be taken not to displace the brachial artery and the nerves that are with it. Dissection of muscles and vessels.

Muscles on the Front of the Arm. — The most prominent muscle along the centre of the arm is the biceps; and the one along its inner side, reaching about half way down, is the coraco-brachialis. The brachialis anticus muscle is beneath the biceps. Some muscles of the forearm are connected to the outer and inner condyles of the humerus, as well as to the line above the outer condyle. Position of the muscles of the arm.

The biceps muscle forms the prominence observable on the front of the arm. It is wider at the middle than at either end; and the upper part of the muscle consists of two tendinous pieces or heads, of different lengths, which are attached to the scapula. Biceps has a short and long head. The short head *arises* from the apex of the coracoid process in common with the coraco-brachialis muscle; and the long head is attached to the upper part of the glenoid cavity of the scapula, within the capsule of the shoulder joint. Muscular fibres spring from Origin from the scapula.

each tendinous head of origin, and are blended about the middle of the arm in one fleshy mass; the belly of the muscle thus formed, is somewhat flattened from before back, and is *inserted* by a tendon into the tubercle of the radius. The muscle is superficial except at the extremities: at its upper part the biceps is concealed by the pectoralis major and deltoid muscles; and at the lower end the tendon dips into the hollow in front of the elbow, having previously given an offset to the fascia of the arm. Beneath the biceps are the brachialis anticus muscle, the musculo-cutaneous nerve, and the upper part of the humerus. Its inner border is the guide to the brachial artery below the middle of the humerus, but between it and the vessel above that spot the coraco-brachialis muscle intervenes. The connection of the long head of the biceps with the shoulder joint, and the insertion of the muscle into the radius will be afterwards dissected.

Insertion into radius.

Parts covering

and beneath it.

Inner border is guide to the artery.

The CORACO-BRACHIALIS is a muscle of a roundish form, and is named from its bony attachments. Its *origin* is fleshy from the tip of the coracoid process, and from the tendinous short head of the biceps. Its fibres end below in a tendon, which is *inserted* into a ridge on the inner side of the humerus, that separates the anterior and posterior surfaces, and below the attachment of the deltoid muscle on the outer aspect; from its tendon of insertion an aponeurotic slip is continued upwards to the head of the humerus. Part of the muscle is beneath the pectoralis major, and forms a prominence in the axilla; but the rest is superficial, except at the insertion where it is covered by the brachial vessels and the median nerve. The coraco-brachialis conceals the subscapular muscle, the anterior circumflex artery, and the tendons of the latissimus and teres. Along the inner border is the large artery of the limb with its nerves. Perforating it is the musculo-cutaneous nerve.

Coraco-brachialis is named from the attachments.

Connections of surrounding parts.

The BRACHIAL ARTERY is a continuation of the axillary trunk, and supplies vessels to the upper limb. It begins at the lower border of the teres major muscle, and ends rather below the bend of the elbow, or "opposite the neck of the radius," in two branches — radial and ulnar, for the forearm.

Brachial artery extends to elbow.

In the upper part of its course the vessel is internal to the

Position to bone,

humerus, but afterwards it is in front of that bone; and its situation is indicated, on the surface, by the depression along the inner border of the biceps and coraco-brachialis muscles. In all its extent the brachial artery is very superficial; for it is covered only by the integuments and the deep fascia, except at the bend of the elbow where it is crossed, in addition, by the median basilic vein and the prolongation from the tendon of the biceps. Posteriorly the artery has the following muscular connections: whilst it is inside the humerus it is placed over the long head of the triceps, and on the inner head of the same muscle; but when the vessel has turned to the front of the bone, it lies on the insertion of the coraco-brachialis and on the brachialis anticus. To the outer side of the vessel are the coraco-brachialis and biceps muscles, the latter somewhat overlapping it in the lower part of the arm.

and situation in the limb.

Connections with muscles and fasciæ,

Veins. — Venæ comites lie on the sides of the artery, encircling it with branches; and the basilic vein is near the line of the artery, but separated from it by the fascia in the lower half of the arm.

with veins,

The *nerves* in relation with the artery are the following: — The internal cutaneous is in contact with the vessel until it has perforated the fascia about the middle of the arm. The ulnar nerve lies to the inner side as far as the insertion of the coraco-brachialis muscle; and the musculo-spiral is behind the artery for a distance of about two inches. The median nerve is close to the vessel in all its course, but alters its position in this way: — as low as the insertion of the coraco-brachialis the nerve is on the outer side, but it then crosses obliquely either over or under the artery, and is placed internal to the vessel about two inches above the elbow joint.

and with nerves.

Branches spring both externally and internally from the brachial artery. Those on the outer side are *muscular*, and supply the coraco-brachialis and biceps; those on the inner side are named superior and inferior profunda, anastomotic, and nutritious arteries.

Its branches are muscular,

a. The *superior profunda* branch is larger than the others, and leaves the artery near the lower border of the tendon of the teres major; it winds backwards with the musculo-spiral nerve to the triceps muscle, and will be dissected with the back of the arm.

superior profunda,

inferior profunda, *b.* The *inferior profunda* branch arises opposite the coraco-brachialis muscle, and accompanies the ulnar nerve to the interval between the olecranon and the inner condyle of the humerus. In the spot mentioned, it anastomoses with the posterior ulnar recurrent and anastomotic branches, and supplies the triceps. It often arises in common with the superior profunda artery.

nutrient of the bone, *c.* A *nutritious* artery to the bone is given off near the preceding branch, and enters the large aperture about the middle of the humerus; it is distributed to the osseous substance, and to the membrane lining the medullary canal.

and anastomotic. *d.* The *anastomotic* branch arises from one to two inches above the elbow, and courses transversely inwards, through the intermuscular septum, to the hollow between the olecranon and the inner condyle of the humerus. Here the artery inosculates with the inferior profunda and the posterior ulnar recurrent branch, and gives some branches to the triceps muscle: one of the muscular offsets forms an arch across the back of the humerus, with a branch of the superior profunda, near the articulation of the elbow. The anastomotic branch likewise sends an offset in front of the elbow joint, which joins with the anterior ulnar recurrent, and supplies the pronator teres muscle.

Veins end in the axillary. The *brachial veins* are placed along the artery, one on each side, and have branches of communication across that vessel; they receive contributing veins, which correspond to the branches of the arteries. Superiorly they join the axillary vein near the subscapular muscle.

Deviations in position. *Peculiarities of the artery in position.* — The brachial trunk may leave the inner border of the biceps in the lower half of the arm, and course along the inner intermuscular septum, with or without the median nerve*, to the inner condyle of the humerus. At this spot the vessel is directed to its ordinary position in front of the elbow, either through or beneath the fibres of the pronator teres, which has then a wide origin. In this unusual course the artery is often found to lie behind a projecting bony point in the humerus.

In place of division. In the *division.* — Occasionally the artery is split for a short distance at its upper part, like the main vessel in the lower limb. And the terminal bifurcation of the vessel may be short of the ordinary spot, or beyond it: — the former condition is much the most frequent; for only in one instance did Mr. Quain find the

* I have seen the nerve in this unusual position without its companion artery, being accompanied by an offset from the superior profunda.

vessel carried farther into the limb before it bifurcated, and in that example the point of division was "between two and three inches" beyond the elbow joint.

In the *origin of the arteries of the forearm.* — The arteries of the forearm, viz. radial, ulnar, and interosseous, may be carried backwards, along the parent trunk, to any point between the axilla and the common source at the elbow; but this unusual origin is not seated with equal frequency on every part of the humeral trunk, for it is most common in the upper third, and least frequent in the middle third where a ligature may be applied. When one of the vessels referred to thus deviates from the ordinary condition, there would be two large arteries in the arm in the place of one; and these commonly lie close together, though sometimes one of them, viz. the trunk that is to supply the front of the forearm and the palm of the hand, will lie close to the intermuscular septum, with the median nerve, like the trunk of the brachial artery. In origin of usual arteries of fore-arm.

In some few cases the brachial artery has been observed to divide into three instead of two branches (radial, ulnar, and interosseous) at some little distance above the elbow, so that three trunks would be present in a given part of the arm. In one case the three arteries of the forearm sprang from the end of the brachial below the elbow, a condition resembling the origin of the arteries of the lower limb from the end of the popliteal trunk. Unusual branching.

In *aberrant branches.* — Occasional long slender vessels, "vasa aberrantia," connect the brachial or the axillary trunk with one of the arteries of the forearm, or with a branch of them. These accessory vessels very rarely end in the ulnar artery. In aberrant branches.

In *muscular covering.*— In some bodies the humeral artery is covered by an additional slip of origin of the biceps or the brachialis anticus muscle. And sometimes a slip of the brachialis may conceal, in cases of high origin of the radial, the remainder of the arterial trunk that continues to the forearm. In muscular covering.

Nerves of the Arm. — The nerves on the front of the arm are derived from the terminal cords of the brachial plexus. Few of them furnish offsets to the arm, but they are continued, for the most part without branching, to the forearm and the hand. The cutaneous branches of some of them have been referred to (p. 279.). Nerves on front of arm.

The *median nerve* arises from the brachial plexus by two roots, one from the outer, and the other from the inner cord of the nerves (p. 262.); its destination is the palm of the hand, and it accompanies the brachial artery to the forearm. Commencing on the outer side of the artery, the nerve crosses over or under the vessel about the middle of the arm Median nerve in the arm is with the artery

as before said (p. 283.), and is found on the inner side a little above the elbow. It does not give any branch in the arm, but there may be a fasciculus connecting it with the musculo-cutaneous nerve. Its connections with muscles are the same as those of the artery.

has not any branch in the arm.

Ulnar nerve changes its direction.

The *ulnar nerve* is derived from the inner cord of the brachial plexus, and in its progress to the inner side of the hand, it courses along the inner part of the arm, and enters the forearm at the inner side of the elbow joint. At first the nerve lies close to the inner side of the axillary, and then to the same side of the brachial artery as far as the insertion of the coraco-brachialis: but in the remainder of the arm it leaves the vessel, and directed inwards through the inner intermuscular septum, it descends, almost surrounded by the muscular fibres of the triceps, to the interval between the olecranon and the inner condyle. There is not any branch given from this nerve till it reaches the elbow joint, but a branch from the musculo-spiral to the triceps muscle accompanies it in the lower part of its course.

Is without branch as far as the elbow.

Internal cutaneous nerve beneath the fascia.

The *internal cutaneous* is a tegumentary nerve of the forearm, to which it is prolonged like the others. Part of the nerve has been before seen, and only that small portion which is beneath the fascia of the limb, remains to be studied in the arm. Arising from the inner cord of the plexus, it is at first internal, and then becomes superficial to the humeral artery as far as the middle of the arm, where it divides into two branches that perforate the investing fascia (p. 280.). Near the axilla it furnishes a small cutaneous offset to the integuments of the arm, which pierces the fascia higher than the trunk of the nerve.

Nerve of Wrisberg

The *small internal cutaneous nerve* (nerve of Wrisberg *) is distributed in the part of the arm now dissected. It arises with the preceding. Concealed at first by the axillary vein, it is directed inwards, either beneath or through the vein, and joins with the intercosto-humeral nerve. Afterwards it lies along the inner part of the arm, as far as the middle, where it perforates the fascia to end in the integument (p. 280.).

beneath the fascia.

* An account of this nerve is given by Klint. See a paper in Ludwig's *Scriptores Nevrologici Minores*, tom. iii. "De Nervis Brachii."

The *musculo-cutaneous nerve* (nerv. perforans, Casserii) is so named from supplying both muscles and integument: it ends on the surface of the forearm, and supplies offsets to the flexors of the elbow joint whilst it is passing through the upper arm. It leaves the outer cord of the brachial plexus opposite the lower border of the pectoralis minor, and perforates directly the coraco-brachialis: it is then directed obliquely to the outer side of the limb, between the biceps and brachialis anticus muscles. Near the elbow, its continuation has been seen to become a cutaneous nerve of the forearm. Musculo-cutaneous nerve in the arm.

The nerve furnishes branches to the muscles in front of the humerus, viz. to the coraco-brachialis, as it passes through the fibres, and to the biceps and brachialis anticus muscles where it lies between them. Before perforating the coraco-brachialis, the nerve gives usually a separate twig to that muscle and the short head of the biceps; and sometimes there is a large branch of communication with the median nerve after it has pierced the muscle. Its muscular branches.

Dissection. — The brachialis anticus muscle will be brought into view by cutting through the tendon of the biceps near the elbow, and turning upwards this muscle. The fascia and connective tissue should be taken from the surface, and the lateral extent of the muscle defined; so as to show that the brachialis reaches the intermuscular septum largely on the inner side, but only for a short distance above, on the outer side. Dissection.

The BRACHIALIS ANTICUS covers the elbow joint, and the lower half of the front of the humerus. Brachialis anticus. It *arises* from all the anterior surface of the humerus below the insertion of the deltoid muscle, and from the intermuscular septa on the sides, though in very unequal proportions, viz. from all the inner, but from only the upper part of the outer one. Origin. The fleshy fibres converge to a tendon, which is *inserted* into the impression on the ulna before the coronoid process. Insertion. This muscle is concealed by the biceps, by the brachial artery, and by the median, and the musculo-cutaneous and musculo-spiral nerves; and it lies on the humerus and the articulation of the elbow. Its origin embraces by two parts the attachment of the deltoid, and its insertion is placed between two corresponding fleshy pieces of the flexor profundus Position over the elbow joint,

and connections. digitorum. The inner border touches the intermuscular septum in all its length; but the outer border is in contact with the external intermuscular septum only above, for about one inch and a half, and is separated from it lower down by two muscles of the forearm (supinator longus and extensor carpi radialis longior), which extend upwards on the humerus. The tendon of insertion will be seen in the dissection of the forearm.

BACK OF THE ARM.

Position of the part. *Position.* — During the examination of the back of the arm the limb is to be turned over, and raised into a semi-flexed position by means of a block of moderate thickness beneath the elbow. The scapula is to be drawn away, till it is nearly in a line with the humerus, so as to tighten the muscular fibres; and it is then to be fastened with hooks in that position.

How to lay bare triceps. *Dissection.* — On the back of the arm there is only one muscle, the triceps, with the superior profunda nerve and artery beneath it. The muscle will be readily laid bare, for it is covered only by fascia — the skin having been before reflected, if the directions before given have been followed by the dissector. To take away the fascia, an incision is to be carried along the limb to rather below the elbow; and in reflecting it the subfascial loose tissue should be removed at the same time.

Triceps muscle has three heads. The TRICEPS muscle is divided superiorly into three parts; and, as a consequence, three heads of origin to it, — inner, outer, and middle, have been described. Two of these are attached to the humerus, and one to the scapula.

Origin of middle head, The *middle* piece, or head, is the longest, and has a tendinous origin, about an inch wide, from the inferior costa of the scapula close to the glenoid cavity, where it is connected with the capsule of the shoulder joint. The *external* head reaches from the outer condyle of the humerus to the insertion of the teres minor muscle, and is attached to the outer portion of the posterior surface of that bone, between the points mentioned, as well as to the intermuscular septum of the same side. The *internal* head reaches from the inner condyle to the upper border of the tendon of insertion of the teres major into the bicipital groove, and arises from the

contiguous intermuscular septum, and the inner portion or half of the posterior surface of the bone. From these processes of origin the fibres are directed to a common tendon of *insertion* at the lower part, with different degrees of inclination: — those of the middle head are directed vertically, but those of the inner and outer heads pass inwards and downwards to the sides and the under part of the tendon. The muscle is inserted inferiorly into the end of the olecranon process of the ulna, and gives an expansion to the aponeurosis of the forearm: between the tip of the olecranon and the tendon is a small bursa. Insertion. Direction of the fibres.

The triceps is superficial, except at the upper part where it is overlapped by the deltoid muscle. It lies on the humerus, and conceals the musculo-spiral nerve, the superior profunda vessels, and the articulation of the elbow. On the sides the muscle is united to the intermuscular septa, and the lower fibres of the outer head are continuous with the anconeus — one of the muscles of the forearm. Connections of the muscle.

Subanconeus muscle. — This is a thin fleshy stratum beneath the triceps near the elbow, which may be seen by cutting through that muscle at the lower part. It consists of two fasciculi, inner and outer: these are attached above the fossa for the olecranon, and end in the capsule of the joint. A corresponding muscle is placed beneath the extensor of the knee joint. Subanconeal slip.

The *intermuscular septa* are processes of fibrous structure, continuous with the investing aponeurosis of the arm, which are fixed to the ridges leading to the condyles of the humerus: they intervene between the muscles on the front and back of the lower half of the arm, and give attachment to the fleshy fibres. The *internal* is the strongest, and reaches as high as the coraco-brachialis muscle, from which it receives some tendinous fibres: the brachialis anticus is attached to it in front, and the triceps behind; and the ulnar nerve and the inferior profunda and anastomotic arteries pierce it. The *external* septum is thinner, and ceases at the deltoid muscle. Behind it is the triceps; and in front of it are the brachialis anticus, and the muscles of the forearm that arise above the condyle of the humerus (supinator longus and extensor carpi radialis longus): it is pierced by the musculo-spiral nerve. Two intermuscular septa attached to ridges of humerus. An inner and outer.

Dissection of vessels and nerve.

Dissection.— To follow now the superior profunda vessels and the musculo-spiral nerve, the middle head of the triceps should be cut across over them, and any fatty tissue that may obscure their position should be removed. To trace out the branches of the nerve and artery, that descend to the olecranon and the anconeus muscle, the triceps is to be divided in its whole length, and along the line of union of the outer with the middle head. The trunks of the vessel and nerve are to be afterwards followed beneath the outer head of the triceps to the front of the humerus.

Superior profunda artery

The *superior profunda* branch of the brachial artery (p. 283.) is the chief vessel for the supply of the triceps muscle. Accompanying the musculo-spiral nerve, it turns to the back of the humerus in the interval between the inner and outer heads of the triceps. In this position the artery supplies large muscular branches, and is then continued onwards beneath the external head of the triceps to the outer part of the arm, where it divides into its terminal twigs:—one of these courses on the nerve to the front of the elbow joint, anastomosing with the recurrent radial artery: whilst others continue to the elbow along the intermuscular septum, and join the interosseous recurrent artery.

lies behind the humerus.

Supplies triceps, and forms a circle around joint.

Branches.— The *muscular* offsets of the vessel descend to the olecranon, supplying the triceps, and communicating with the other branches of the brachial artery, viz. inferior profunda and anastomotic (p. 284.), as well as with the recurrent branches of the arteries of the forearm. One offset deserves especial notice; it accompanies a distinct branch of the musculo-spiral nerve, and ends in the anconeus muscle in the interval between the olecranon and the outer condyle of the humerus.

Musculo-spiral nerve winds behind humerus

The *musculo-spiral nerve* arises from the posterior cord of the brachial plexus, of which it is the largest trunk, and is continued along the back, and the outer part of the limb to the hand. In the arm the nerve is first placed behind, and close to the axillary and brachial arteries; but it soon leaves the last vessel, and winds with the profunda artery from the inner to the outer part of the arm, beneath the triceps muscle. At the outer aspect of the limb it is continued between the brachialis anticus and supinator longus muscles to the external condyle of the humerus, in front of

to outer side of the arm.

which it divides into the radial and posterior interosseous nerves. In this extent the nerve gives muscular branches, and cutaneous offsets to both the inner and outer parts of the arm. Branches.

a. The *internal cutaneous* branch of the arm is of small size, and arises in the axillary space, in common with the branch to the inner head of the triceps; it is directed across the posterior boundary of the axilla to the inner side of the arm, where it becomes cutaneous in the upper third, and is distributed as before said (p. 280.). Internal cutaneous branch.

b. The *muscular* branches to the triceps are numerous, and supply all the three heads. One slender offset, that is distributed to the inner head, arises in common with the preceding cutaneous branch, and lies close to the ulnar nerve, till it enters the muscular fibres at the lower third of the arm. And a long slender branch behind the humerus, that appears as if it ended in the triceps, can be followed downwards to the anconeus muscle. On the outer part of the limb the musculo-spiral nerve supplies the brachialis anticus, and two muscles of the forearm, viz. supinator longus and extensor carpi radialis longior. Branches to the triceps, brachialis and muscles of fore-arm.

c. The *external cutaneous* branches are two in number: they perforate the outer head of the triceps at its attachment to the humerus, and are distributed in the integument of the arm and forearm (p. 279.). Two external cutaneous.

Dissection. — Now the dissection of the arm has been completed as far as the elbow, it will be advisable to examine next the shoulder joint. For this purpose the tendons of the surrounding muscles, viz. those of the subscapularis, supra- and infraspinatus, and teres minor, must be detached from the joint. On the removal of the connective and some loose fibrous tissue, the articular capsule, with a thickened band on the fore part, will be prepared. Dissection of the shoulder joint.

SHOULDER JOINT.—The joint is formed between the head of the humerus and the glenoid fossa of the scapula, these parts being inclosed in a fibrous capsule lined by a synovial membrane. A ligamentous band (glenoid ligament) deepens the shallow cavity for the reception of the large head of the humerus. This articulation has great extent of movement; and the bones entering into its formation are but slightly bound together by ligamentous bands, for, on the removal of the muscles, the articular surface of the humerus may be drawn from the other with great readiness. Shoulder joint; outline of.

Capsular ligament. The *capsular ligament* surrounds the articular ends of the bones, and receives some fibres from the contiguous tendons. At the upper part it is fixed around the neck of the scapula, where it is connected with the long head of the triceps. Attachments. At the lower part the ligament is attached to the humerus close to the hemispherical articular surface; but its continuity is interrupted between the tuberosities of that bone by the tendon of the biceps muscle. On the inner side, below the coracoid process, there is generally an aperture in the capsule through which the synovial membrane of the joint is continuous with the bursa beneath the tendon of the subscapularis. Muscles around. The following muscles surround the articulation: — superiorly are the tendons of the supraspinatus, infraspinatus, and teres minor; inferiorly the capsule is only partly covered by the subscapularis: and internally it is well supported by the last named muscle.

Accessory band. On the front of the capsule is a rather thick band of fibres, — the *coraco-humeral* or *accessory* ligament, which springs from the base of the coracoid process of the scapula, and ends in the great tuberosity of the humerus.

Dissection. *Dissection.*—The articulation is to be opened by cutting through the capsule near the scapula. When this has been done, the attachment of the capsule to the bones, the glenoid ligament, and the tendon of the biceps will be fully seen.

Tendon of the biceps. The *tendon of the biceps* muscle arches over the head of the humerus, and serves the purpose of a ligament in restraining the upward movements of that bone. It is attached to the upper part of the glenoid fossa of the scapula, and is connected on each side with the glenoid ligament. As it is directed outwards, it becomes round, and is received into the groove between the tuberosities of the humerus, in which it is covered by a prolongation from the tendon of the pectoralis major muscle, and surrounded by the synovial membrane.

Glenoid ligament. The *glenoid ligament* is a firm, fibrous band, that surrounds the fossa of the same name, deepening it for the reception of the head of the humerus. It is about two lines in depth, and is connected in part with the sides of the tendon of the biceps; but some of its fibres are fixed separately to the edge of the glenoid fossa.

Synovial The *synovial membrane* lines the articular surface of the

capsule. At the aperture on the inner side of the capsule it is continued beneath the subscapularis muscle. The membrane is further reflected around the tendon of the biceps, and lines the bicipital groove of the humerus. membrane.

Section IV.

THE FRONT OF THE FOREARM.

Position.— The limb is to be placed with the palm of the hand uppermost; and the marking of the surface, and the projections of bone, are first to be noted. Position of the limb.

Surface-marking. — On the anterior aspect of the forearm are two depressions, corresponding to the position of the chief vessels. The external one is placed over the radial artery, and inclines towards the middle of the limb as it approaches the elbow. The internal one is evident only beyond the middle of the forearm, and points out the part of the ulnar artery that is uncovered by muscle. The bones (radius and ulna) are sufficiently near the surface to be traced in their whole length: each ends below in a point, — the styloid process, and that of the radius is the lowest. The articulation of the wrist is about an inch above the transverse marking that separates the forearm from the hand. Surface of the fore-arm.

On each side of the palm of the hand is a lateral projection; the external of these is formed by the muscles of the thumb, and the internal by the muscles of the little finger. Between those projections is a hollow, which is pointed towards the wrist. The superficial palmar arch of arteries extends forwards a little way into the hollow, and its position may be marked by a line drawn across the palm from the root of the thumb, when that digit is placed at a right angle to the hand. Two transverse lines are seen in the palm, but neither reaches completely across it: the anterior one serves to direct to the line of the articulations between the metacarpus and the phalanges, and is about a quarter of an inch behind those joints, when the fingers are extended, except in the case of the fore finger. Surface of palm of the hand.

Transverse lines are seen on both aspects of the joints of the thumb and the fingers. The lines on the palmar surface Surface of the fingers.

of the fingers may be used to point out the articulations of the phalanges. Thus the joint between the metacarpal phalanx and the next will be found about a line in front of the chief of the transverse grooves, that appear about the middle (in length) of the finger; whilst the articulation between the two last phalanges is situate about a line in front of the single groove which is nearer the tip of the finger.

Dissection to remove the skin. *Dissection.*—With the position of the limb still the same, an incision is to be carried through the skin along the middle of the front of the forearm, as far as an inch beyond the wrist; and at its termination another transverse one is to be united with it. The skin is next to be reflected carefully from the front and back of the forearm, without injury to the numerous superficial vessels and nerves that are beneath; and it should also be taken from the back of the hand, by prolonging the ends of the transverse cut along the margins of the hand to a little beyond the knuckles. One finger should have the integument removed from it, in order that the nerves may be traced to the end.

Seek the superficial vessels and nerves in front, The superficial vessels and nerves can be now traced in the fat. They have the following position: — Along the inner side of the forearm are the ulnar veins, with the continuation of the internal cutaneous nerve; and near the wrist there is occasionally a small offset from the ulnar nerve. On the outer side are the radial vein, and the superficial part of the musculo-cutaneous nerve. Close to the hand, in the centre of the forearm, is the small palmar branch of the median nerve.

behind. At the back of the forearm the external cutaneous branch of the musculo-spiral nerve is to be traced; and offsets are to be followed to this surface from the nerves in front. On the posterior part of the hand is an arch of superficial veins. The radial nerve, and a branch of the ulnar nerve, should be found on the back of the hand, as they run to the fingers, — one along the outer, the other along the inner border of the hand.

Subcutaneous veins of the forearm are CUTANEOUS VEINS. — The superficial veins are named median, radial, and ulnar, from their position in the limb. They commence in the hand, chiefly at the dorsal aspect, where they form an arch, and are continued along the

forearm to end in the basilic and cephalic veins of the arm.

Superficial arch. — This arch on the back of the hand is more or less perfect, and receives the posterior or superficial digital veins. At the sides the arch terminates in the radial and ulnar veins. Arch on the hand;

The *radial vein* begins in the outer part of the arch before mentioned, and in some small radicles from the back of the thumb. It is then continued along the forearm, at first behind and then on the outer border, as far as the elbow, where it gives rise to the cephalic vein by its union with the outer branch of the median vein. radial;

The *ulnar veins* are anterior and posterior, and occupy the front and the back of the limb. The *anterior* arises near the wrist, by the junction of small roots from the hand, and runs on the inner part of the forearm to the elbow; here it unites with the inner branch of the median, and forms the basilic vein. The *posterior* ulnar vein is situate on the back of the limb. It commences on the hand by the union of a large branch, "vena salvatella," from the back of the little finger, with the offset of the venous arch; it is then continued along the back of the forearm nearly to the elbow, and bends forwards to open into the anterior ulnar vein. ulnar; two sets, anterior and posterior;

The *median vein* commences on the front of the arm, near the wrist, by small branches which are derived from the palmar surface of the hand, and is directed along the centre of the forearm nearly to the elbow. Here the vein divides into external and internal branches (median basilic and median cephalic), which unite, as before seen (p. 278.) with the radial and ulnar veins. At its point of bifurcation the median receives a communicating branch from a vein accompanying the artery beneath the fascia. median.

Cutaneous Nerves. — The superficial nerves of the forearm are continued from those of the arm, viz. on the inner part, from the large internal cutaneous nerve; and on the outer part, from the two external cutaneous nerves derived from the musculo-spiral, and from the musculo-cutaneous. Occasionally there is a small offset of the ulnar nerve to the integument in this part of the limb. On the back of the hand is the termination of the radial nerve, together with a branch of the ulnar nerve. Superficial nerves of forearm and back of hand are

The *internal cutaneous nerve* was seen in a previous dissection (p. 280.) to be divided into two parts. The *anterior* branch extends on the front of the forearm as far as the wrist, and supplies the integument on the inner half of the anterior surface. Near the wrist it communicates sometimes with a cutaneous offset internal cutaneous;

from the ulnar nerve. The *posterior* branch continues along the back of the forearm (ulnar side) to rather below the middle.

musculo or external cutaneous; The *cutaneous part* of the musculo-cutaneous nerve is continued from the arm, and courses along the radial border of the limb as far as the ball of the thumb, on which it terminates in cutaneous offsets. Near the wrist the nerve is placed over the radial artery, and some twigs pierce the fascia to ramify on the vessel. A little above the middle of the forearm the nerve gives backwards a branch to the integument on the posterior aspect, that reaches nearly to the wrist, and communicates with the radial nerve as well as with the following cutaneous nerve.

external cutaneous of musculo-spiral. The *external cutaneous branch* of the musculo-spiral nerve, after passing the elbow, turns to the posterior aspect of the forearm, and reaches as far as the wrist. Near its termination it joins the preceding cutaneous nerve.

Ending of the radial nerve The *radial nerve* is distributed to the integument of the back of the hand, and to that of the thumb and the next two fingers. It becomes cutaneous at the outer border of the forearm in the lower third, and after giving backwards some filaments to the posterior aspect of the limb, divides into two branches:—

by external and internal branch; *a.* One (external) is joined by the musculo-cutaneous nerve, and is distributed to the radial border and the ball of the thumb. *b.* The other branch (internal) supplies the remaining side of the thumb, both sides of the next two digits, and half the ring finger; so that the radial nerve supplies the same number of digital branches on the dorsal aspect as the median nerve furnishes on the palmar aspect. This division of the radial nerve communicates with the musculo-cutaneous and ulnar nerves; and the offset, which is distributed to the contiguous sides of the ring and middle fingers, is joined by a twig from the dorsal branch of the ulnar nerve.

which supply the fingers.

Termination. On the sides of the fingers each of these dorsal digital nerves is united with an offset from the corresponding digital nerve on the palmar surface, and then extends to the tip of the finger.

Branch of ulnar nerve to back of hand and fingers. The *dorsal branch* of the *ulnar nerve* furnishes offsets to the rest of the fingers and to the back of the hand. Appearing by the styloid process of the ulna, this branch joins in an arch across the back of the hand with the radial nerve, and is then distributed to both sides of the little finger, and to the contiguous side of the ring finger: moreover, it communicates with the part of the radial nerve that supplies the space between the ring and middle fingers. The ulnar nerve will be afterwards seen to supply branches to the same number of digits on the palmar surface.

Deep fascia of the forearm. The *aponeurosis* of the forearm is continuous with a similar investment of the arm; it furnishes the muscles

with sheaths, and is thicker behind than before. It is of a pearly white colour, and is formed of fibres that cross obliquely. Near the elbow it is stronger than towards the hand; and at that part it receives fibres from the tendons of the biceps and brachialis anticus, and gives origin to the muscles attached to the inner condyle of the humerus. On the back of the limb, the aponeurosis is connected to the margins of the ulna, so as to leave the upper part of that bone subcutaneous; and it receives some fibres from the tendon of the triceps. Horizontal processes are sent downwards from the aponeurosis to separate the superficial and deep layers of muscles, both on the front and the back of the forearm; and longitudinal white bands indicate the position of the different intermuscular processes, which isolate one muscle from another, and give origin to the muscular fibres.

On the back of the limb.

Inter-muscular pieces.

At the wrist the fascia joins the anterior annular ligament; and near this band the tendon of the palmaris longus pierces the fascia, and receives a sheath from it. Behind the wrist it is thickened by transverse fibres, and gives rise to the posterior annular ligament; but on the back of the hand and fingers the fascia becomes very thin.

At the wrist;

annular ligament.

Dissection.— The skin is to be replaced on the back of the forearm and hand, in the same manner as on the back of the arm, in order that the parts that are denuded may not become dry. Beginning with the dissection of the anterior aspect of the limb, let the student divide the aponeurosis along the front as far as the wrist, and take it away with all the cutaneous vessels and nerves, except the small palmar cutaneous offsets of the median and ulnar nerves near the wrist. In cleaning the muscles, it will be impossible to remove the aponeurosis from them, at the upper part of the forearm, without detaching the muscular fibres.

Take away fascia, nerves, and veins.

After the aponeurosis has been removed, the termination of the brachial artery will be observed to lie with some fat in a hollow in front of the elbow, between two masses of muscles,— one arising from the inner, and the other from the outer condyle of the humerus. Two large arteries are in part laid bare; one (radial) lies along the radial border, the other (ulnar) is superficial only in the lower half of the forearm, and at the ulnar side. These vessels and their branches should be carefully cleaned.

Vessels then seen.

Define anterior annular ligament.

The anterior annular ligament of the wrist, which arches over the tendons passing to the hand, is next to be defined. This structure is at some little depth from the surface; whilst the student attempts to make it apparent by removing the tissue superficial to it, he must take care of the small branches of the median and ulnar nerves to the palm of the hand. The ulnar artery and nerve pass over the ligament, and will serve as a guide to it.

Hollow in front of the elbow.

Hollow in front of the elbow. — The hollow in front of the bend of the elbow corresponds with that of the popliteal space in the leg, and is situate between the inner and the outer mass of the muscles of the forearm. This interval is somewhat triangular in shape, and the wider part is towards the humerus. Laterally, it is bounded on the outer side by the supinator longus muscle, and on the inner side by the pronator teres. The aponeurosis of the limb is stretched over the space; and the bones, covered by the brachialis anticus and supinator brevis muscles, form the deep boundary.

Boundaries.

Contents of the space

Contents. — In this hollow are lodged the termination of the brachial artery with its veins and the median nerve, the musculo-spiral nerve, the tendon of the biceps muscle, and some fatty tissue; these several parts have the following relative position in the space: — the tendon of the biceps is directed towards the outer boundary to reach the radius, into which it is inserted; and the musculo-spiral nerve is close to the outer side, being partly concealed by the supinator longus muscle, The brachial vessels and the median nerve occupy nearly the centre of the space, the nerve being internal; but as the artery is inclining to the outer part of the limb, they are soon distant from one another about half an inch. In this space the brachial artery divides into two trunks — radial and ulnar.

and their position to one another.

Superficial layer has five muscles.

MUSCLES ON THE FRONT OF THE FOREARM. — The muscles on the anterior and inner parts of the forearm are divided into a superficial and a deep layer. In the superficial layer there are five muscles, which are fixed to the inner condyle of the humerus, mostly by a common tendon, and lie in the undermentioned order from the middle to the inner side of the limb; viz. pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, which are on the same level; and deeper and larger than any of these is

the flexor sublimis digitorum. The deep layer will be met with in a future dissection.

Pronator teres.

The PRONATOR RADII TERES arises from the inner condyle of the humerus by the common tendon, and by fleshy fibres from the ridge above the condyle; from the inner part of the coronoid process by a second tendinous slip; and from the fascia and the intermuscular septum between it and the next muscle. It is *inserted* by a rather flat tendon into an impression, an inch in length, on the outer surface of the middle of the radius. The muscle is superficial except at its insertion where it is crossed by the radial artery, and is concealed by one of the outer set of muscles (supinator longus). The pronator forms the outer boundary of the triangular space in front of the elbow; and its inner border is contiguous to the flexor carpi radialis. By gently separating the muscle from the rest, it will be found to lie on the brachialis anticus, on the flexor sublimis digitorum, and on the ulnar artery and the median nerve. The second small head of origin is directed inwards between the artery and the nerve.

Origin.

Insertion.

Connections.

Radial flexor of the wrist

The FLEXOR CARPI RADIALIS takes its origin from the common tendon, from the aponeurosis of the limb, and from the intermuscular septum on each side. The tendon of the muscle, becoming free from fleshy fibres about the middle of the forearm, passes through a groove in the os trapezium, outside the arch of the anterior annular ligament, and is *inserted* into the base of the metacarpal bones of the index and middle fingers. This muscle rests chiefly on the flexor sublimis digitorum; but near its origin it is in contact with the ulnar artery and the median nerve, and near the wrist it lies over the flexor longus pollicis,—a muscle of the deep layer. As low as the middle of the forearm the muscle corresponds externally to the pronator teres, and below that point to the radial artery, to which its tendon is taken as the guide. The ulnar border is at first in contact with the palmaris longus muscle, and then with the median nerve for about two inches above the wrist.*

is superficial;

is the guide to the radial artery.

Long palmar muscle

The PALMARIS LONGUS is often absent; or it may present great irregularity in the proportion between its fleshy and

* In one body, that of a woman, and well developed, the muscle was absent on both sides.

tendinous parts. Its origin is connected, like that of the preceding muscle, with the common tendon, the fascia, and the intermuscular septa. Its long thin tendon is continued along the centre of the forearm, and over the annular ligament, to end in the palmar fascia. The palmaris is situate between the flexor carpi radialis and flexor carpi ulnaris muscles, and rests on the flexor sublimis digitorum.

lies over annular ligament and ends in fascia of palm.

Flexor carpi ulnaris. Origin.

The FLEXOR CARPI ULNARIS has an aponeurotic attachment to the inner condyle of the humerus; to the inner side of the olecranon; and to the ridge of the ulna, between the internal and posterior surfaces, for three fourths of its length. Most of the fibres are continued vertically downwards, but others obliquely forwards to a tendon which occupies the anterior part of the muscle in the lower half, some joining it as low as the wrist; and the tendon is *inserted* into the pisiform bone, whilst an offset is sent to the annular ligament, and the muscles of the little finger. One surface of the muscle is in contact with the fascia; and its tendon may be taken as the guide to the ulnar artery, since it can be readily felt through the skin. To its radial side are the palmaris and flexor digitorum sublimis muscles, but below the middle of the forearm the ulnar artery and nerve are placed along it. When the attachment to the inner condyle has been divided, and the subjacent parts cleaned, the muscle will be seen to conceal the flexor digitorum sublimis and flexor profundus, the ulnar nerve, and the ulnar vessels in part. Between the attachments to the condyle and the olecranon the ulnar nerve enters the forearm.

Insertion into pisiform bone.

Adjacent parts.

Course and extent of the radial artery.

The RADIAL ARTERY is one of the vessels derived from the bifurcation of the brachial trunk, and its destination is the palm of the hand. It is first placed along the outer side of the forearm as far as the end of the radius; it then winds backwards below the extremity of that bone; and it enters finally the palm of the hand through the first interosseous space. In consequence of this circuitous course the artery will be found in three different regions; viz. the front of the forearm, the back of the wrist, and the palm of the hand.

Situation in the forearm.

In the front of the forearm.—In this part of the limb the position of the artery will be marked, on the surface, by a line drawn from the centre of the hollow of the elbow to the fore part of the styloid process of the radius. This

vessel is smaller than the ulnar artery, though it appears in direction to be the continuation of the brachial trunk.

In all its extent the radial artery is quite superficial, being covered only by the common tegumentary investments, and the deep fascia, and during life it can be felt beating as the pulse near the wrist. Its connections with the surrounding muscles and the radius are these: — in the upper half of the forearm the artery is placed between the supinator longus externally and the pronator teres internally, the former somewhat overlapping it; but below that point it lies between the tendons of the supinator longus and flexor carpi radialis. At first the vessel is on the inner side of the radius, but afterwards over that bone; it is placed successively over the following parts, viz. the fleshy supinator brevis, the tendon of the pronator teres, the thin radial origin of the flexor sublimis, some muscles of the deep layer, viz. flexor pollicis longus and pronator quadratus, and lastly on the end of the radius. The usual venæ comites are found on the sides of the artery. The radial nerve is on the outer side of, though not in contact with the vessel, in the upper two thirds of the forearm, or until it passes backwards beneath the tendon of the supinator longus, and becomes cutaneous. Connections with parts over it, on the sides, behind and with the radius. Veins and nerve with it.

Branches. — The radial artery furnishes many unnamed muscular and nutrient branches to the surrounding parts; and three named branches, viz. recurrent radial, superficial volar, and anterior carpal. Branches both muscular and anastomotic.

a. The *radial recurrent* is the first branch of the artery, and supplies the muscles of the outer side of the limb. Its course is almost transverse to the supinator longus muscle, beneath which it terminates in muscular ramifications. One offset ascends beneath the supinator, and anastomoses with the superior profunda branch of the brachial artery. Radial recurrent.

b. The *superficial volar* branch usually arises near the lower end of the radius, but its exact place of origin is uncertain. It is directed towards the palm of the hand, across or through the mass of muscles in the ball of the thumb, and it either ends in those muscles, or joins the superficial palmar arch. Superficial volar.

c. The *anterior carpal* branch is very inconsiderable in size, and will be seen in the examination of the deep layer of muscles. Arising rather above the lower end of the radius, this artery passes transversely beneath the muscles, and anastomoses with a similar Anterior carpal.

branch from the ulnar artery. From the arch thus formed at the lower border of the pronator quadratus muscle, offsets are given to the carpus.

Variations in the origin.

Peculiarities of the radial artery.—The origin of the radial artery may be carried upwards in the arm, from the usual place even to the axilla; and the unusual beginning of this vessel in the humeral is much more frequent than that of either of the other arteries of the forearm, bearing to their variation in this particular the proportion in a given number of cases of about three to four. In one instance (Quain), it was noticed between two and three inches below the elbow joint, and in that case a vas aberrans connected it with the axillary artery. When the radial artery has a high origin, its course in the arm is close to the brachial artery, along the edge of the biceps muscle; and in passing the bend of the elbow it may be occasionally subcutaneous, viz. above the deep fascia, and be liable to injury in venesection. In the forearm it may be likewise subcutaneous, and superficial to the supinator longus muscle.

and course of the radial.

Connecting branches.

The *aberrant arteries*, "vasa aberrantia," or the long slender branches of the axillary or brachial trunks, open commonly into the radial artery. In some cases of high origin of the radial, there is a connecting branch, at the bend of the elbow, between that irregular vessel and the trunk in the place of the brachial artery.

Dissection.

Dissection.—To bring into view the remaining muscle of the superficial layer (flexor sublimis digitorum), the origin of the flexor carpi radialis and palmaris longus must be cut through near the inner condyle of the humerus, and turned to one side. Small branches of the ulnar artery and median nerve may be seen to enter the under surface of those muscles. For the present, the pronator teres may be left uncut.

Superficial flexor of fingers.

The FLEXOR DIGITORUM SUBLIMIS vel PERFORATUS is the largest of the muscles of the superficial layer, and is named from its position to another flexor in the deep layer of muscles.

Origin.

It *arises* from the inner condyle of the humerus, from the internal lateral ligament, and from the intermuscular septa, in common with the preceding muscles; and it takes origin in addition from the bones of the forearm, viz. from the inner part of the coronoid process of the ulna; and from the oblique line extending from the tubercle of the radius; as well as from the anterior border of that bone as far as two inches below the insertion of the pronator

teres.* Rather below the middle of the forearm the muscle ends in four tendons, which are continued across the hand to be *inserted* into the middle phalanges of the fingers, after being perforated by the tendons of the deep flexor. Insertion.

The flexor sublimis is concealed above by the other muscles of the superficial layer; and the radial vessels lie on the attachment to the radius. Along the inner border is the flexor carpi ulnaris, with the ulnar vessels and nerve. The tendons of the muscle are arranged in pairs before they enter beneath the annular ligament of the wrist; those of the middle and ring fingers being anterior, and those of the index and little finger posterior in position. When the coronoid and condyloid attachments are divided, the muscle will be seen to cover two flexors of the deep layer (flexor digitorum profundus and flexor pollicis), the median nerve and the upper part of the ulnar artery. Connections with parts around.

The ULNAR ARTERY is the larger of the two branches from the bifurcation of the brachial trunk, and is directed along the inner side of the limb to the palm of the hand. At its extremity it forms the superficial palmar arch, and joins the radial artery. Ulnar artery ends in palm of hand.

In the forearm the vessel has an arched direction, and its depth from the surface varies in the first and last parts of its course. In the upper half of the forearm the artery is inclined obliquely inwards, between the superficial and deep layers of muscles, and is covered by the former, viz. by the pronator teres, flexor sublimis, palmaris longus, and flexor carpi radialis. But below the spot mentioned, the vessel is quite superficial between the tendons of the flexor sublimis and flexor carpi ulnaris, and is concealed only by the common integuments and the proper fascia of the limb, though the flexor ulnaris somewhat overlays it, and serves as the guide to its position. Beneath the artery will be found first the brachialis anticus for a short distance, and afterwards the flexor profundus. Connections in the upper and lower half of the forearm.

The two companion veins are situate on the sides of the artery. The median nerve lies to the inner side of the vessel for about an inch, but then crosses over that trunk to gain Position of veins and nerves.

* Oftentimes this origin does not extend lower than the attachment of the pronator muscle.

the outer side. About the middle of the forearm, the ulnar nerve approaches the artery, and continues thence on the inner side. A small branch of the ulnar nerve descends on its lower part to the palm of the hand.

Position on the annular ligament. On the annular ligament of the wrist, the artery lies close to the pisiform bone, and is crossed by a band of fibres prolonged from the tendon of the flexor carpi ulnaris to that ligament. The ulnar nerve still accompanies the vessel, having the same position, viz. on the inner side.

Its branches besides muscular are *Branches.*—The greater number of the collateral branches of the artery are distributed to the muscles. But the branches which are named are the following: —

anterior and *a.* The *anterior ulnar recurrent* branch arises generally in common with the next, and turns upwards on the brachialis anticus muscle, to inosculate with the small anastomotic artery beneath the pronator radii teres. It gives offsets to the contiguous muscles.

posterior recurrent, *b.* The *posterior ulnar recurrent* branch, of larger size than the anterior, is directed inwards beneath the flexor sublimis muscle to the interval between the inner condyle and the olecranon. Here it passes with the ulnar nerve between the attachments of the flexor carpi ulnaris, and joins the ramifications of the inferior profunda and anastomotic arteries on the inner side of the elbow joint. Some of its offsets enter the muscles, and others supply the articulation and the ulnar nerve.

interosseous, *c.* The *interosseous* branch is a short, thick trunk, about an inch long, which is directed backwards towards the interosseous membrane, and divides into anterior and posterior interosseous arteries: these branches will be afterwards followed.

metacarpal, *d.* The *metacarpal* branch arises from the artery near the lower end of the ulna, and turns back along the metacarpal bone of the little finger, of which it forms a dorsal branch.

and carpal. *e.* The *carpal* branches (anterior and posterior) ramify on the front and back of the carpus, on which they anastomose with corresponding offsets of the radial artery, and form arches across the wrist.

The origin *Peculiarities of the ulnar artery.*—The *place* of *origin* of the ulnar artery has a tendency to approach the trunk of the body, and it may therefore be changed to any point of the vessel in the arm, or even to that in the axilla; but this deviation is much less frequent in it than in the radial artery. Once the origin was found between two and three inches below the elbow. (Quain.)

and course of the ar- Its *position* in the forearm, when the vessel is irregular, is more frequently changed than that of the radial under similar circum-

stances. Commonly, in the instances of high origin, the ulnar artery is superficial to the flexor muscles at the bend of the elbow (only one exception, Mr. Quain), but beneath the aponeurosis of the forearm, though sometimes it is subcutaneous with the superficial veins. tery may vary.

The ULNAR NERVE enters the forearm between the attachments of the flexor carpi ulnaris to the olecranon and the inner condyle of the humerus. Under cover of that muscle the nerve reaches the ulnar artery about the middle (in length) of the forearm, and is then continued on the inner side of the vessel to the hand. On the annular ligament the nerve is rather posterior to the artery. In this part of the limb it furnishes articular, muscular, and cutaneous branches as below : — Ulnar nerve in the fore-arm. Its branches are

a. Articular nerves.— In the interval between the olecranon and the inner condyle, the ulnar nerve gives slender filaments to the articulation against which it lies. to elbow joint,

b. Muscular branches.— It furnishes offsets near the elbow joint to two muscles of the forearm, viz. flexor carpi ulnaris and flexor profundus. One branch enters the upper part of the flexor carpi ulnaris, and the other supplies the inner half of the flexor profundus digitorum. to two muscles of fore-arm,

c. Cutaneous nerve of the forearm and hand.— About the middle of the forearm a small cutaneous branch (palmar) arises from the nerve, and continues on the ulnar artery, sending twigs around it, to end in the integuments of the palm of the hand. Sometimes a cutaneous offset from it perforates the aponeurosis near the wrist, and joins the internal cutaneous nerve. cutaneous branch of palm of hand,

d. The *dorsal cutaneous nerve of the hand* arises about two inches above the end of the ulna, and passes obliquely backwards beneath the flexor carpi ulnaris muscle: it finally perforates the aponeurosis of the limb, and is lost on the back of the hand and fingers (p. 296.). cutaneous nerve of back of hand.

The MEDIAN NERVE leaves the hollow of the elbow between the heads of origin of the pronator teres, and takes the middle line of the limb in its course to the hand. It is placed beneath the flexor sublimis as low as two inches from the annular ligament, but it then becomes superficial along the outer border of the tendons of that muscle. Lastly the nerve dips beneath the annular ligament to enter the palm of the hand, where it is distributed. This is the nerve for the supply of the muscles on the front of the forearm, for it furnishes cutaneous offsets only to the hand. Median nerve lies between the two layers of muscles.

Supplies the muscles, except one and a half,

a. Muscular offsets leave the trunk of the nerve near the elbow, and are distributed to all the muscles of the superficial layer except the flexor carpi ulnaris; in addition, the nerve supplies the deep layer through the following branch (interosseous), except a part, viz. the inner half of the flexor profundus digitorum.

in both layers.

b. The *anterior interosseous nerve.*— By means of this nerve, the remaining muscles of the deep layer are supplied, with the exception above specified. It accompanies the anterior interosseous artery, and will be dissected with that vessel.

A cutaneous branch to palm of hand.

c. The *cutaneous palmar branch* arises at the lower part of the forearm; it pierces the fascia near the annular ligament, and crosses the ligament to reach the palm of the hand.

Radial nerve in the forearm, ends on back of the hand.

The RADIAL NERVE is the larger of the two branches into which the musculo-spiral divides in front of the outer condyle of the humerus. This nerve is placed along the outer border of the limb, under cover of the supinator longus, and on the outer side of the radial artery till within three inches of the wrist, where it becomes cutaneous at the posterior part of the tendon of the supinator. On the surface of the limb it divides into two branches, which are distributed on the dorsum of the hand, and on the thumb and the next two fingers (p. 296.). No offset is furnished by the part of the nerve beneath the aponeurosis.

Dissection of deep layer of muscles.

Dissection.— To examine the deep layer of muscles it will be necessary to draw well over to the radial side of the forearm the pronator teres and flexor sublimis muscles; or if it is thought necessary, these muscles may be divided. The connective tissue is to be taken from the muscular fibres; and the anterior interosseous vessels and nerve, which lie on the interosseous membrane and are concealed by the muscles, are to be traced out.

Three muscles in the deep layer.

DEEP LAYER OF MUSCLES.— Only three muscles are present in the deep layer on the front of the forearm. One lies on the ulna, and is the deep flexor of the fingers; another covers the radius,— the long flexor of the thumb; and the third is the pronator quadratus, which is beneath the other two, near the lower end of the bones.

Deep flexor of fingers. Origin.

The FLEXOR DIGITORUM PROFUNDUS vel PERFORANS arises from the anterior and inner surfaces of the ulna for three fourths of the length of the bone, and from the inner half of the interosseous ligament for the same distance; from the inner part of the olecranon; and from an aponeurosis common

to this muscle and the flexor carpi ulnaris. The muscle has a thick fleshy belly, and ends in four tendons, which are not separate above the annular ligament, and whose destination is the last phalanges of the fingers. The cutaneous surface of the muscle is in contact with the ulnar nerve and vessels, and with the superficial flexor of the fingers, and the flexor carpi ulnaris; and the deep surface rests on the ulna and the pronator quadratus muscle. The outer border touches the flexor pollicis longus and the anterior interosseous vessels and nerve; and the inner is connected by the aponeurosis to the posterior margin of the ulna.

Is attached to last phalanges.

Parts around it.

The FLEXOR LONGUS POLLICIS arises from the upper two thirds of the hollowed anterior surface of the radius, as low as the pronator quadratus; from the outer part of the interosseous membrane; and by a round distinct slip from the coronoid process of the ulna, internal to the attachment of the brachialis anticus. The fleshy fibres descend to a tendon, which is continued beneath the annular ligament, and is *inserted* into the last phalanx of the thumb. On the cutaneous surface of the muscle is the flexor sublimis, together with the radial vessels for a short distance inferiorly; and the muscle lies on the radius and the pronator quadratus. To the inner side is the flexor profundus digitorum.

Long flexor of thumb. Origin.

Insertion.

Parts above and beneath it.

The PRONATOR QUADRATUS is a flat muscle, and occupies the lower fourth of the front of the bones of the forearm. The muscle *arises* from the anterior and inner parts of the ulna, where it is somewhat the widest, and is *inserted* into the fore part of the radius for about two inches. The anterior surface is covered by the tendons of the flexor muscles of the fingers, and by the radial artery; and the posterior surface rests on the radius and ulna with their intervening membrane, and on the interosseous vessels and nerve.

Pronator quadratus is on lower end of bones of forearm; is deep in position.

The *anterior interosseous artery* (p. 304.) is continued on the front of the interosseous membrane, between or in the fibres of the deep flexor muscles, till it reaches the aperture below that membrane. At that spot the artery turns from the front to the back of the limb, and descends to the posterior surface of the carpus, where it ends by anastomosing with the posterior interosseous and carpal arteries.

Anterior interosseous artery.

Its branches chiefly muscular. *Branches.* — Numerous offsets are given to the contiguous muscles. One long branch, *median*, accompanies the median nerve, supplying it, and either ends in the flexor sublimis, or Median: extends beneath the annular ligament to the hand. About to the bones. the middle of the forearm two nutrient vessels of the bones arise from the artery. Where it is about to turn backwards, it furnishes twigs to the pronator quadratus, and one branch is continued beneath that muscle to anastomose with the anterior carpal arteries.

Anterior interosseous nerve ends in pronator. The *anterior interosseous nerve* is derived from the median (p. 306.), and accompanies the artery of the same name to the pronator quadratus muscle, on the under surface of which it ends. Some lateral branches are distributed by it to the deep flexor muscles.

Section V.

THE PALM OF THE HAND.

Dissection. Seek the cutaneous nerves. *Dissection.* — Without any change in the position of the hand, the skin is to be reflected from the palm by means of two incisions. One is to be carried along the centre of the hand from the wrist to the fingers; and the other is to be made from side to side, at the termination of the first. In raising the inner flap, the small palmaris brevis muscle will be recognised at the inner margin of the hand, near the wrist. In the fat the ramifications of the small branches (palmar) of the median and ulnar nerves are to be found.

Define the palmar fascia, The student should remove the fat from the small muscle, and from the strong palmar fascia in the centre of the hand, and should be careful not to destroy a thin transverse band of tissue (transverse ligament), that passes across the roots of the fingers. When cleaning the fat from the palmar fascia he will recognise the digital vessels and nerves, and must be especially careful of two: — viz. those of the inner side of the little finger and outer side of the index finger, which appear farther back than the rest, and are most likely to be injured.

and expose digital sheaths. Lastly, the skin and the fat may be reflected from the thumb and the fingers by an incision along each, so that the sheaths of the tendons with the collateral vessels and nerves may be laid bare.

Two cutaneous palmar nerves.

Cutaneous palmar nerves.— Two named cutaneous nerves ramify in the palm of the hand. *a.* One of these is an offset of the median nerve (p. 306.), and crosses the annular ligament: it extends to about the middle of the palm, and is connected with the palmar branch of the ulnar nerve. A few filaments of this nerve are furnished to the ball of the thumb. *b.* The other palmar branch is derived from the ulnar nerve (p. 305.); it has been already traced on the ulnar artery to the hand, and it may be now observed as far as its distribution in the palm.

One of median, other of ulnar nerve.

Some unnamed twigs.

Some unnamed twigs are furnished to the integument from both the median and ulnar nerves in the hand.

Palmaris brevis is subcutaneous,

The PALMARIS BREVIS is a small subcutaneous muscle, about an inch and a half wide, whose fibres are collected into separate bundles. It is attached on the outer side to the palmar aponeurosis, and its fibres are directed inwards to join the skin at the inner border of the hand. This muscle lies over the ulnar artery and nerve. After it has been examined, it may be thrown inwards.

and ends in the skin.

Palmar fascia.

The *palmar fascia*, or aponeurosis, consists of a central and two lateral parts; but the latter, which cover the muscles of the thumb and little finger, are so thin as not to require a separate notice.

Its central part

The *central part* is a strong, white, shining layer, which is pointed at the wrist; but is expanded towards the fingers, where it covers nearly the width of the hand. Posteriorly this portion of the fascia receives the tendon of the palmaris longus, and is connected to the annular ligament; and anteriorly it ends in four processes, which are continued forwards, one for each finger, and form part of the sheaths of the tendons. At the point of separation of the processes one from another some transverse fibres are placed, which arch over the lumbricalis muscle and the digital artery and nerve that appear at this spot. From the four pieces into which the fascia divides, a few superficial longitudinal fibres are prolonged to the integument near the cleft of the fingers.

ends in a piece for each finger,

and the skin.

Dissection.

Dissection.— To follow one of the processes of the fascia to its termination, the superficial fibres must be first removed, and it must be then divided longitudinally, by inserting the knife beneath it opposite the head of the metacarpal bone.

Deep ending of the

Ending of the processes. — The process of the fascia may be seen to send downwards an offset on each side of the

pieces of fascia. tendons, which is fixed to the ligament connecting together the ends of the metacarpal bones, as well as to the borders of a metacarpal bone for a short distance. The same disposition exists in each of the processes.

Ligament of the fingers. The *transverse ligament of the fingers* is a thin fibrous band, which stretches across the roots of the fingers, and is contained in the fold of skin forming the rudiment of a web between them. Beneath it the digital nerves and vessels are continued onwards to their terminations.

Sheath of the tendons varies in thickness. *Sheath of the flexor tendons.*— Along each finger the flexor tendons are retained in position against the phalanges by a fibrous sheath. Opposite the middle of each of the two nearest phalanges, the sheath is formed by a strong fibrous band (ligamentum vaginale), which is almost tendinous in consistence ; but opposite the joints of the fingers it consists of scattered and oblique fibres that form a thin membrane.

Has a synovial sac. If the sheath be opened, it will be found to be lined by a synovial membrane that lubricates the tendons, and forms long and slender vascular folds (vincula vasculosa) between the tendons and the bones.

Dissection. *Dissection.* — The palmar fascia, and the thinner parts of the sheaths of the tendons opposite the joints of the fingers, may be now taken away. On the removal of the fascia, the palmar arch of arteries and the median and ulnar nerves become apparent.

Superficial palmar arch. Palmar Part of the Ulnar Artery. — In the palm of the hand the ulnar artery is directed outwards towards the muscles of the thumb, where it communicates with two offsets of the radial artery, viz. the superficial volar branch, and the branch to the radial side of the fore finger. The curved part of the artery, which lies across the hand, is named the *superficial palmar arch.* Its convexity is turned towards

Position in the hand and connections. the fingers, and its position in the palm would be marked nearly by a line across the hand from the cleft of the thumb. The arch is comparatively superficial; it is covered in greater part only by the integuments and the palmar fascia, but at the inner border of the hand the palmaris brevis muscle overlies it. Beneath it are the flexor tendons and the branches of the ulnar and median nerves.

Branches are *Branches.*— From the convexity of the arch proceed the digital arteries, and from the concavity, some small offsets

to the palm of the hand. A small branch (profunda) arises as soon as the artery enters the hand.

a. The *deep* or communicating *branch* (profunda) is small in size, and passes downwards with a branch of the ulnar nerve between the abductor and short flexor muscles of the little finger, to inosculate with the deep palmar arch of the radial artery. to join the deep arch.

b. The *digital branches* are four in number, and supply both sides of the three inner fingers and one side of the index finger. The branch to the inner side of the hand and the little finger is undivided in its course; but the others correspond to the three inner interosseous spaces, and bifurcate anteriorly to supply the contiguous sides of the abovesaid digits. In the hand these branches are accompanied by the digital nerves, which they sometimes pierce. Near the root of the fingers each receives a communicating branch from the vessels of the deep arch; but the artery for the inner side of the little finger has its communicating offset with the deep arch about the middle of the hand. Four digital branches. In the hand.

From the point of bifurcation the branches extend along the sides of the fingers, accompanied by the digital nerves; and on the last phalanx the vessels of opposite sides unite in an arch, from whose convexity offsets proceed to supply the papillæ of the ball of the finger, as well as the pulp beneath the nail. Collateral branches are furnished to the finger and the sheath of the tendons; and small twigs are supplied to the phalangeal articulations from small arterial arches on the bone, one being close behind each joint. Termination on sides of the fingers.

Palmar Part of the Ulnar Nerve. — The ulnar nerve divides on the annular ligament or near it, into a superficial and a deep branch; these are distributed to one finger and a half, and to some of the muscles of the hand. Ulnar nerve in the hand

The *deep branch* accompanies the profunda artery to the muscles, and will be subsequently dissected with that vessel. has a deep and

The *superficial branch* furnishes an offset to the palmaris brevis muscle, and some filaments to the integument of the inner part of the hand, and then ends in two digital nerves for the supply of both sides of the little finger and half the next: — superficial part.

Digital nerves. — The more internal nerve is undivided, like the corresponding artery. The other is directed to the The last ends in two di-

gital nerves, for little finger and half next. cleft between the ring and little fingers, where it bifurcates for the supply of their opposed sides. In the palm of the hand this last branch is connected with an offset from the median nerve. Along the sides of the fingers the digital branches have the same arrangement as those of the median nerve.

Median nerve in the hand supplies muscles and fingers. PALMAR PART OF THE MEDIAN NERVE. — As soon as the median nerve issues from beneath the annular ligament into the palm of the hand, it becomes enlarged and somewhat flattened, and is divided into two nearly equal parts: from these divisions the digital nerves to the thumb, and to the remaining two fingers and a half are derived. The more external of the two portions furnishes likewise a small muscular branch to the ball of the thumb. The trunk of the nerve and its branches are covered in the hand by the palmar fascia; and beneath them are the tendons of the flexor muscles.

Branch to the muscles. The *branch to the muscles of the thumb* supplies the outer half of the short flexor, and ends in the abductor and opponens pollicis muscles.

Digital nerves are five, and supply thumb and two fingers and a half. The *digital nerves* are five in number. Three of them, which are distributed to the sides of the thumb and the radial side of the fore finger, are undivided, and are furnished by the external of the two parts into which the trunk of the median divides; the other two spring from the inner branch resulting from the division of that nerve, and are bifurcated to supply the opposed sides of the middle and fore, and the middle and ring fingers.

First two, The *first two* nerves belong to the thumb, one being on each side, and the most external communicates with branches of the radial
third, nerve. The *third* is directed to the radial side of the index finger, and gives a branch to the most external lumbrical muscle. The
fourth, *fourth* furnishes a nerve to the second lumbrical muscle, and divides to supply the contiguous sides of the fore and middle fingers. The
fifth. *fifth*, like the fourth, is distributed by two branches to the opposed sides of the middle and ring fingers: it is joined by a branch from the ulnar nerve.

Termination on the sides of the fingers. *On the fingers.* — On the sides of the fingers the nerves are superficial to the arteries, and reach to the last phalanx, where they end in filaments over the ball on the front of the finger, and for the pulp beneath the nail. In their course

forwards, the nerves supply chiefly tegumentary branches: one of these is directed backwards by the side of the metacarpal phalanx, and after uniting with the digital nerve on the back of the finger (p. 296.), is continued to the dorsum of the last phalanx.

Dissection. — The tendons of the flexor muscles may be followed next to their termination. For that purpose the ulnar artery should be cut through below the origin of the profunda branch; and the small superficial volar branch (of the radial) having been also divided, the arch is to be thrown forwards to the fingers. The ulnar and median nerves are then to be cut below the annular ligament, and turned forwards. A longitudinal incision is to be made through the centre of the annular ligament, without injuring the small muscles that arise from it, and the pieces of the ligament are to be thrown to the sides. Finally the sheaths of the fingers may be opened for the purpose of observing the insertion of the tendons. Dissection of deep tendons.

Flexor tendons. — Beneath the annular ligament the tendons of the deep and superficial flexors are surrounded by a large and loose synovial membrane, which projects upwards into the forearm and downwards into the hand, and sends an offset into the digital sheath of both the thumb and the little finger. In the hand the tendons of the deep flexor give attachment to the small lumbrical muscles. Synovial sac surrounds tendons.

Tendons of the flexor sublimis.—The tendons of the flexor sublimis are superficial to those of the deep flexor beneath the ligament; and the four tendons are nearly on the same level, instead of being arranged in pairs as in the forearm. Crossing the palm of the hand, the tendons enter the sheaths of the fingers, and are *inserted* by two processes into the margins of the middle phalanx, about the centre. When first entering the digital sheath, the tendon of the flexor sublimis conceals that of the flexor profundus; but near the front of the first phalanx it is slit for the passage of the tendon of the latter muscle. Tendons of superficial flexor in the hand. Insertion. Are slit for the deep flexor.

Dissection. — To see the tendons of the deep flexor and the lumbrical muscles, the flexor sublimis must be cut through above the wrist, and thrown towards the fingers. A little connective tissue must be taken away. Dissection.

Tendons of the flexor profundus. — At the lower border of Tendons

of deep flexor cross the hand. to their insertion. the annular ligament the tendinous mass of the flexor profundus is divided into four pieces; whilst in the forearm only one tendon, that of the fore finger, is distinct from the rest. From the ligament the four tendons are directed through the hand to the fingers. At the root of the finger each enters the digital sheath with a tendon of the flexor sublimis, and having passed through that tendon, is *inserted* into the base of the last phalanx.

Short folds to both flexor tendons. Between both flexor tendons and the bones are small membranous folds (ligamenta brevia), one for each. By means of this fold each tendon is connected with the fore part of the phalanx, and the capsule of the joint, immediately behind the bone into which it is inserted.*

Lumbrical muscles are attached to deep flexor, and first phalanx. Difference in origin. The *lumbricales muscles* are four small fleshy slips that are connected with the tendons of the deep flexor. They *arise* from the side of the tendons near the annular ligament, and are directed to the radial side of the fingers, one for each, to be *inserted* into an aponeurotic expansion on the dorsal aspect of the first or metacarpal phalanx. These muscles are concealed for the most part by the tendons and vessels that have been removed; but they are subcutaneous for a short distance in the hand between the processes of the palmar fascia. The outer two arise from single tendons, but each of the others is connected with two tendons.

Tendon of long flexor of thumb, to its insertion. *Tendon of the flexor pollicis longus.*—Beneath the annular ligament this tendon is external to those of the flexor profundus; it then turns outwards between the heads of the flexor brevis pollicis, and is *inserted* into the last phalanx of the thumb. The common synovial membrane surrounds it beneath the annular ligament, and sends a prolongation, as before said, into its digital sheath.

Dissection of muscles of thumb *Dissection.*—The deep palmar arch of the radial artery and the interossei muscles will come into view if the flexor profundus is cut above the wrist, and thrown with the lumbricales muscles towards the fingers; but in raising the ten-

* In the ligament to the long flexor tendon Mr. Marshall finds two thin bands of elastic tissue, which he names the *vincula subflava.* He assigns to those bands the office of drawing down the long tendons after bending of the fingers. — On certain Elastic Structures connected with the Deep Flexor Tendons of the Fingers and Toes. By John Marshall, F.R.C.S.—'*Med.-Chir. Review*, Jan. 1853.

dons the student should endeavour to preserve two small nerves that enter the two inner lumbrical muscles.

The dissection of the short muscles of the ball of the thumb and of the little finger is next to be prepared. Some care is necessary to make a satisfactory separation of the different small muscles of the thumb: those of the little finger are more easily defined. and little finger.

Short muscles of the thumb.—These are four in number, and are named from their action on the thumb. The most superficial is the abductor pollicis; beneath it is the opponens pollicis, which will be recognised by its attachment to the whole length of the metacarpal bone. To the inner side of the last is the short flexor; and the wide muscle coming from the third metacarpal bone is the adductor of the thumb. Four muscles in the ball of the thumb, viz.

The abductor pollicis is thin, about an inch wide, and is superficial to the rest. It *arises* from the upper part of the annular ligament at the radial side, and from the ridge of the os trapezium; and is *inserted* into the outer part of the base of the first phalanx of the thumb. The muscle is subcutaneous, and rests on the opponens pollicis: it is oftentimes connected at its origin with a slip from the tendon of the extensor ossis metacarpi pollicis. Abductor. Attachments. Is the most superficial.

Dissection. — The opponens pollicis will be seen on cutting through the abductor. To separate this muscle from the short flexor on the inner side, the student should begin near the farther end of the metacarpal bone, where there is usually a slight interval. Dissection.

The opponens pollicis *arises* from the lower part of the annular ligament beneath the preceding, and from the os trapezium and its ridge; it is *inserted* into the front and the outer border of the metacarpal bone for the whole length. This muscle is partly concealed by the preceding, though it is larger and projects on each side. Along its inner border is the flexor brevis pollicis. An insertion into the external sesamoid bone is described by M. Theile. Opponens fixed to metacarpal bone, beneath former.

The flexor brevis pollicis is the largest of the short muscles of the thumb: it consists of two parts (inner and outer) at the insertion, but these are partly united at the origin. The *outer head*, the smallest, arises partly beneath the opponens from about the two outer thirds of Flexor brevis arises by two heads,

the annular ligament, at the lowest part, and from the os magnum. The *inner head* has a wide origin from the os trapezoides and os magnum, from the sheath of the flexor carpi radialis, and from the bases of the second and third metacarpal bones. The heads are soon blended in one mass; and this is *inserted* by two parts into the sides of the base of the first phalanx of the thumb, — the inner piece being united with the adductor, and the outer with the abductor pollicis. A sesamoid bone is connected with each lateral piece at its insertion. The tendon of the long flexor lies on this muscle, and afterwards occupies the interval between the processes of insertion; and the deep palmar arch comes from beneath the inner head.

And is inserted by two heads.

It is deep in the hand.

Adductor crosses from third metacarpal bone,

The ADDUCTOR POLLICIS is pointed at the thumb, and wide at the opposite end. Its *origin* is fixed to the anterior two thirds of the metacarpal bone of the middle finger, on the anterior aspect; and its *insertion* is attached, with that of the short flexor, to the inner side of the first phalanx of the thumb. The cutaneous surface is in contact with the tendons of the flexor profundus and their lumbrical muscles; and the deep surface lies over (in this position) the abductor indicis in the first interosseous space, and the second and third metacarpal bones and the intervening muscles.

joins short flexor, and is deep in the hand.

Two or three muscles to little finger.

SHORT MUSCLES OF THE LITTLE FINGER. — There are commonly two muscles in the ball of the little finger, — an abductor and an adductor. Sometimes there is a short flexor muscle between the other two.

Abductor

is the most external.

The ABDUCTOR MINIMI DIGITI is the most internal of the short muscles. It *arises* from the pisiform bone and the tendon of the flexor carpi ulnaris, and is *inserted* into the ulnar side of the base of the first phalanx of the little finger; an offset is sent from it to the extensor tendon on the back of the phalanx. The palmaris brevis partly conceals the muscle.

Flexor brevis is often absent.

Is on the inner side of

The FLEXOR BREVIS MINIMI DIGITI appears to be only a part of the abductor. Placed at the radial border of the preceding muscle, it takes *origin* from the tip of the process of the unciform bone, and slightly from the annular ligament; it is *inserted* with the abductor into the first phalanx. It lies on the adductor; and near its origin it is separated from the

abductor muscle by the deep branches of the ulnar artery and nerve. preceding.

The ADDUCTOR vel OPPONENS MINIMI DIGITI resembles the opponens pollicis in being attached to all the length of the metacarpal bone. Its *origin* is from the process of the unciform bone, and from the lower part of the annular ligament: its *insertion* is fixed into the ulnar margin of the metacarpal bone of the little finger. This is partly overlaid by the preceding muscles; and beneath it the deep branches of the ulnar artery and nerve pass. Opponens is fixed to metacarpal bone.

Dissection. — The radial artery comes into the palm of the hand between the first two metacarpal bones; and to lay it bare, it will be requisite to detach the inner head of the flexor brevis pollicis at the origin. The deep palmar arch, and the branch of the ulnar nerve that accompanies it, together with their offsets, are to be dissected out. A fascia, which covers the interossei muscles, is to be removed, when the dissector has observed its connection with the transverse ligament uniting the heads of the metacarpal bones. Dissection of deep arch and interossei muscles.

RADIAL ARTERY IN THE HAND.— The radial artery enters the palm of the hand at the first interosseous space, between the heads of the abductor indicis muscle: and after furnishing one branch to the thumb, and another to the index finger, turns across the hand towards the ulnar side, and thus forms the deep palmar arch. Radial artery in hand

The *deep palmar arch* extends from the interosseous space to the base of the metacarpal bone of the little finger, where it joins the communicating branch (profunda) of the ulnar artery. Its convexity, which is but slight, is directed forwards, and its position is more posterior, or nearer the carpal bones, than that of the superficial arch. The arch has a deep position in the hand, and lies on the metacarpal bones and the interossei muscles; it is covered by the long flexor tendons, and in part by the inner head of the flexor brevis pollicis. The *branches* of the deep palmar arch are the following: — forms deep arch which lies near carpal bones and beneath all muscles. Branches of the arch.

a. Recurrent branches pass from the concavity of the arch to the front of the carpus; these supply the bones, and anastomose with the other carpal arteries. Recurrent. *b.* Three *perforating arteries* pierce the interossei muscles, and communicate with the interosseous arteries on the back of the hand. Perforating. *c.* Usually there are three *palmar inter-* Interosseous.

osseous arteries, which occupy the three inner metacarpal spaces, and terminate by joining the digital branches of the superficial palmar arch at the clefts of the fingers: these branches supply the interosseous muscles, and vary much in their size and distribution.

Other branches of radial.

Branches of the radial artery. — As soon as the radial artery enters the hand, it gives off the large artery of the thumb, and the digital branch of the index finger: —

Digital artery of the thumb.

The *large artery of the thumb* (art. princeps pollicis) runs along the metacarpal bone of the thumb, between the abductor indicis and the flexor brevis pollicis, to reach the interval between the heads of the last muscle, where it divides into the two collateral digital branches of the thumb. The distribution of these is the same as that of the arteries of the superficial arch.

Digital artery of the fore finger.

The *digital branch of the index finger* (art. radialis indicis) is directed over the abductor indicis, and beneath the short flexor and the adductor pollicis, to the radial side of the fore finger. At the free or anterior border of the abductor indicis this branch is connected by an offset with the superficial palmar arch; and at the end of the finger it unites with the digital branch furnished to the opposite side by the ulnar artery.

Deep branch of ulnar nerve.

The *deep branch of the ulnar nerve* accompanies the deep palmar arch of the radial artery as far as the muscles of the thumb, and terminates in branches to the adductor pollicis, the inner head of the short flexor, and the abductor indicis.

Muscular offsets.

Branches.— Near its origin the nerve furnishes branches to the muscles of the little finger. In the palm it gives an offset to each palmar and dorsal interosseous muscle, and to each of the two inner lumbrical muscles, besides the terminal branches to the muscles before mentioned.

Ligament of heads of metacarpal bones.

The *transverse metacarpal ligament* connects together the heads of the metacarpal bones. Its cutaneous surface is hollowed where the flexor tendons cross it; and beneath it the interossei muscles pass to their insertion. To the posterior border the fascia that covers the interossei muscles is united. This ligament should be taken away to see the interossei muscles.

Seven inter-

The INTEROSSEI MUSCLES are so named from their position between the metacarpal bones, and are seven in number. Two muscles occupy each space, except the first in which

there is only one, and they are inserted into the first phalanx of the fingers. They are divided into palmar and dorsal interossei; but all the small muscles are evident in the palm of the hand, though some project more than the others. ossei muscles, divided into palmar and dorsal.

The *palmar* muscles are three in number, and are smaller than the dorsal set, although they are most prominent in the palm of the hand. Undivided at the posterior part, they *arise* from the palmar surface of the metacarpal bones of the fingers on which they act, viz. those of the fore, ring, and little fingers; and are inserted into the ulnar side of the fore, and the radial side of the other two digits (supposing the hand supine): their attachments may be kept in mind by considering them adductors of the fingers before mentioned to the middle line of the second. Number and origin of palmar attachments.

The *dorsal* interossei extend farther back than the palmar set, and *arise* by a double head from the lateral surfaces of the two metacarpal bones between which they lie. The dorsal muscles are thus allotted to the digits: — two belong to the middle finger, one is connected with the radial side of the fore, and one with the ulnar side of the ring finger. They may be considered abductors from the middle line of the second finger: thus the two muscles attached to the fore and ring fingers will draw those digits from the middle one; and those that are connected with the middle finger will carry this to the right and left of a line passing through its centre. The first muscle of this set is noticed separately below, under the name abductor indicis. Dorsal set. Number. Attachment and action.

Both sets of muscles have a similar termination: — the fibres end in a tendon, which is *inserted* into the side of the first or metacarpal phalanx, and sends an expansion to join the aponeurotic covering on the dorsum of that bone. Common insertion of both sets.

The *abductor indicis*, or the first dorsal interosseous muscle, *arises* from nearly the whole of the metacarpal bone of the index finger, and from the upper half of that of the thumb; and is *inserted* into the radial side of the first phalanx of the fore finger. By the palmar surface the muscle is in contact with the adductor and flexor brevis pollicis; and by the opposite surface it is subcutaneous. The radial artery perforates it to enter the palm. First dorsal interosseous is a large distinct muscle perforated by radial artery.

Dissection. — The attachments of the annular ligament to the carpal bones on each side may be next dissected out. Dissection.

To define the ligament the small muscles of the thumb and little finger must be taken from it. Before reading the description of this structure, the ends of the cut ligament should be placed in apposition.

Annular ligament of front of wrist.

The *anterior annular ligament* is a firm ligamentous band that arches over and binds down the flexor tendons of the fingers. It is attached externally to the front of the os scaphoides, and to the fore and inner part, as well as the ridge of the os trapezium; and internally to the unciform and pisiform bones. By its upper border it is connected with the aponeurosis of the forearm, and by its anterior surface with the palmar fascia. On the cutaneous surface lie the palmaris longus and the ulnar artery and nerve.

Dissection.

Dissection. — Next follow the tendon of the flexor carpi radialis to its insertion, and dissect out more fully the attachment of the biceps and brachialis anticus muscles to the bones of the forearm.

Insertion of tendon of flexor carpi radialis.

The *tendon of the flexor carpi radialis,* in passing from the forearm to the hand, lies in the groove in the os trapezium between the attachments of the annular ligament to the bone, but outside the arch of that ligament: here it is bound down by a fibrous sheath, lined by a synovial membrane. The tendon is *inserted* into the base of the metacarpal bones of the index and middle fingers.

Insertion of brachialis anticus.

The *insertion of the brachialis anticus* takes place by a broad thick tendon, about an inch in extent, which is fixed into the anterior rough part of the coronoid process of the ulna.

Insertion of the biceps tendon.

Insertion of the biceps. — The tendon of the biceps is inserted into the inner part of the tubercle of the radius, and into the bone behind it. A bursa is found between it and the bone. Near its attachment the tendon changes the direction of its surfaces; the anterior surface becoming external, and *vice versâ.* The supinator brevis muscle partly surrounds the insertion.

Section VI.

THE BACK OF THE FOREARM.

Position. — During the dissection of the back of the forearm, the limb lies with the fore part down, and a small

block is to be placed beneath the wrist for the purpose of stretching the tendons.

Dissection. — The fascia with the cutaneous nerves and vessels is to be reflected from the muscles of the forearm, and from the tendons on the back of the hand; but a thickened band of it (posterior annular ligament), opposite the carpus, is to be left. If the integument has not been taken from the fingers, let the dissector proceed to remove it, in order that the tendons may be traced to the ends of the fingers. The several muscles should be separated from one another up to their origin, especially the two radial extensors of the wrist.

Take away the superficial vessels and the fascia.

The *posterior annular ligament* consists of the special aponeurosis of the limb, thickened by the addition of some transverse fibres, and is situate opposite the lower ends of the bones of the forearm. This ligamentous band is connected at the outer part to the radius, and at the inner to the cuneiform and pisiform bones. It confines the extensor tendons, sending downwards processes, which are fixed to the bones, and form sheaths for those tendons. The ligament will be subsequently examined more in detail.

Annular ligament behind the wrist.

MUSCLES OF THE BACK OF THE FOREARM. — The muscles are arranged in a superficial and a deep layer, like those of the front of the forearm. The superficial layer is composed of seven muscles, which arise mostly by a common tendon from the outer condyle of the humerus, and have the undermentioned position one to another. Proceeding from without inwards, the student will find in succession the long supinator, two radial extensors of the wrist (long and short), the common extensor of the fingers, the extensor of the little finger, and lastly the ulnar extensor of the wrist. There is one other small muscle near the elbow, the anconeus.

Two layers of muscles.

Superficial has seven muscles, viz.

The SUPINATOR RADII LONGUS is contained partly in the arm and partly in the forearm, and limits, on the outer side, the hollow in front of the elbow. The muscle *arises* from the upper two thirds of the outer condyloid ridge of the humerus, and from the front of the external intermuscular septum. The fleshy fibres end above the middle of the forearm in a tendon, by means of which the muscle is *inserted* into the lower end of the radius above the styloid process. In the arm the margins of the supinator are directed from the

Supinator longus arises from humerus,

and is inserted into radius.

surface to the bone, but in the forearm the muscle is flattened over the others, and its edges have an opposite direction, viz. from before backwards. Near its insertion the supinator is covered by two extensors of the thumb. Along its inner border, below the elbow, is the radial artery; and above the joint, it is in contact with the brachialis anticus. Beneath this muscle are found the extensors of the wrist, the radial nerve, and the radius.

Is superficial, and limits hollow in front of the elbow.

Extensor carpi longus is nearly as long as the preceding.

The EXTENSOR CARPI RADIALIS LONGIOR arises from the lower third of the outer condyloid ridge of the humerus, and from the front of the contiguous intermuscular septum. The muscle descends on the short radial extensor; and its tendon passes beneath the extensors of the thumb, and through the annular ligament, to be *inserted* into the base of the metacarpal bone of the index finger. Along its outer border is the radial nerve.

Insertion.

Extensor carpi brevis is contained in the fore-arm.

The EXTENSOR CARPI RADIALIS BREVIOR is attached to the orbicular ligament of the radius; and to the outer condyle of the humerus, by a tendon common to it and the three following muscles, viz. the common extensor of the fingers, the extensor of the little finger, and the ulnar extensor of the wrist: it also takes origin from aponeuroses on its under and inner sides. The tendon of the muscle is closely connected with the preceding, and after passing with it through the same compartment of the annular ligament, is *inserted* into the base of the metacarpal bone of the middle finger. Concealed by the two preceding muscles, this extensor rests on the radius and on some of the muscles attached to it, that is to say, on the supinator brevis, and the pronator teres. Along the inner side is the common extensor of the fingers; and the extensors of the thumb come out between the two. Both the radial extensors of the carpus have usually a bursa at their insertion.

Insertion into metacarpal bone.

Has a common origin with three following.

Common extensor muscle.

Origin in the fore-arm.

The EXTENSOR COMMUNIS DIGITORUM is single at its origin, but is divided inferiorly into four tendons. It *arises* from the common tendon, from aponeurotic septa between it and the muscles around, and from the aponeurosis of the limb. Near the lower part of the forearm the muscle ends in three tendons, which pass through a compartment of the annular ligament with the indicator muscle. Escaping from the ligament, the most internal tendon divides into two, and all

four are directed along the back of the hand to their insertion into the last two phalanges of the fingers.

On the back of the fingers the tendons have the following disposition: — Opposite the first two phalangeal articulations each tendon sends down lateral bands to join the capsule of the joint; and on the dorsum of the first phalanx it forms an expansion with the tendons of the lumbricales and interossei muscles. At the anterior part of the first phalanx this tendinous expansion is divided into three parts: — the central one is fixed into the base of the second phalanx, whilst the lateral pieces unite at the front of the same phalanx, and are inserted into the last. On the fore and little fingers the expansion is joined by the special tendons of those digits. Insertion of the tendons into the phalanges.

This muscle is placed between the extensors of the wrist and little finger, and conceals the deep extensors. The tendon of the ring finger is united by an oblique band with each collateral tendon, so as to prevent the raising of that finger if the other fingers are closed. Connections of the muscle.

The EXTENSOR MINIMI DIGITI is the most slender muscle on the back of the forearm, and appears to be but a part of the common extensor. Its *origin* is in common with that of the extensor communis, but it passes through a distinct sheath of the annular ligament; and its tendon, which is split into two directly afterwards, ends by joining the common expansion on the first phalanx of the little finger. Extensor of little finger. Common origin and termination.

The EXTENSOR CARPI ULNARIS MUSCLE arises from the common tendon and from the aponeurosis of the forearm; it is also firmly fixed by the fascia to the posterior border of the ulna below the anconeus muscle (about the middle third). Its tendon becomes free from fleshy fibres near the annular ligament, and passes through a separate sheath in that structure to be *inserted* into the base of the metacarpal bone of the little finger. Beneath this extensor are some of the muscles of the deep layer, with part of the ulna. On the outer side is the extensor of the little finger. Extensor carpi ulnaris. Origin. Insertion. Is the most internal muscle.

The ANCONEUS is a small triangular muscle near the elbow joint, which *arises* from the outer condyle of the humerus by a tendon distinct from, and posterior to the common tendon of origin of the other muscles. From this origin the fibres diverge to their *insertion* into the outer Anconeus has a distinct origin and insertion;

side of the olecranon, and into the impression on the upper third or more of the posterior surface of the ulna. The upper fibres are nearly transverse, and are contiguous to the lowest of the triceps muscle. Beneath the anconeus are the supinator brevis muscle, and the recurrent interosseous vessels.

is close to the triceps.

Dissection of deep layer of muscles

Dissection. — For the display of the deep muscles of the back of the forearm, and the posterior interosseous artery and nerve, some of the superficial muscles, viz. the extensor communis, extensor minimi digiti, and extensor carpi ulnaris must be detached from their origin, and turned aside: some small branches of the nerve and artery, which will be seen entering the muscles, may be divided. The loose tissue and fat are then to be removed from the muscles, and from the ramifications of the artery and nerve; and a slender part of the nerve, that sinks beneath one muscle (extensor of the second phalanx of the thumb), about the middle of the forearm, should be carefully dissected. The separation of the muscles should be made, but that between the small muscles of the thumb, especially between the highest two, is not always very distinct.

and interosseous vessels and nerve.

Five muscles in the deep layer, viz.

Deep layer of muscles. — In this layer there are five small muscles, viz. one supinator of the forearm, and four special extensor muscles of the thumb and fore finger. The highest muscle, that partly surrounds the upper end of the radius, is the supinator brevis. Below this are the three extensors of the thumb in the following order — one of the metacarpal bone, one of the first, and one of the second phalanx. On the ulna the indicator muscle is placed.

Extensor metacarpi pollicis has a wide attachment.

The extensor ossis metacarpi pollicis (abductor pollicis longus) is the largest and highest of the extensor muscles of the thumb, and is sometimes united with the supinator brevis, below which it lies. It *arises* from the posterior surface of the radius, for about three inches below the supinator brevis; from a special impression of the ulna for about the same distance, on the upper and inner part of the posterior surface; and from the intervening interosseous membrane. The tendon of the muscle is directed outwards over the radial extensors of the wrist, and through the outer compartment in the annular ligament, to be *inserted* into the base of the metacarpal bone of the thumb. The muscle is

Insertion.

at first concealed by the common extensor of the fingers; but it becomes cutaneous between the last muscle and the extensors of the wrist, about two inches above the end of the radius. Opposite the carpus the radial artery winds backwards beneath its tendon. The ulnar attachment is higher than the radial, and begins close below the insertion of the anconeus: between the contiguous borders of this muscle and the supinator brevis, the posterior interosseous artery appears.

The muscle is at first deep, but afterwards superficial.

The EXTENSOR PRIMI INTERNODII POLLICIS is the smallest muscle of the deep layer, and its tendon is closely connected with that of the preceding extensor. Its *origin*, about one inch in depth, is from the radius and the interosseous membrane, close below the attachment of the preceding muscle. Its fibres end in a tendon, which passes through the same space in the annular ligament as the extensor of the metacarpal bone, and is *inserted* into the metacarpal end of the first phalanx of the thumb. With respect to surrounding parts, this muscle has the same connections as the previous one.

Extensor of first phalanx of thumb has a small origin, and lies with preceding.

Insertion into the thumb.

The EXTENSOR SECUNDI INTERNODII POLLICIS varies in the extent of its bony attachment. It arises from the ulna for about three inches in a line with, and below the extensor of the metacarpal bone; and from the interosseous membrane below for one inch; but oftentimes it may be connected with the middle three fifths of the ulna. Its tendon of insertion, after passing through a sheath in the annular ligament distinct from that of the other two extensor muscles, is directed along the dorsum of the thumb to be fixed to the base of the last phalanx. It is covered by the same muscles as the other extensors of the thumb, but it becomes superficial nearer the lower end of the radius. Below the annular ligament its tendon crosses the radial artery, and the tendons of the extensors of the wrist.

Extensor of second phalanx lies alone in the annular ligament.

Insertion.

Is lower than the preceding two.

The EXTENSOR INDICIS (indicator muscle) arises from the ulna for three or four inches, usually below the middle, and internal to the preceding, though the attachment may be carried upwards beyond the centre of the bone. Near the annular ligament the tendon becomes free from muscular fibres, and passing through the ligament with the common extensor of the fingers, is applied to the external tendon of

Indicator muscle.

Origin.

It is applied to common extensor,

and inserted with it. that muscle, and becomes blended with it in the expansion on the first phalanx of the fore finger. Until this muscle has passed the ligament it is covered by the superficial layer but afterwards it is subaponeurotic.

Dissection of supinator brevis. *Dissection.*— To lay bare the supinator brevis, it will be necessary to detach the anconeus from the external condyle of the humerus, and to cut through the supinator longus and the radial extensors of the wrist. After those muscles have been divided, its fibres are to be followed forwards to their insertion into the radius; and that part of the origin of the flexor profundus digitorum, which lies on the outer side of the insertion of the brachialis anticus, is to be removed.

Origin of short supinator; The SUPINATOR BREVIS arises from the orbicular ligament of the radius and the external lateral ligament of the elbow joint; from a depression below the small sigmoid cavity of the ulna; and from the external margin of the ulna below that depression for about two inches. From this origin the and insertion into the radius. fibres pass outwards, and are *inserted* into the upper third or half of the radius except at the inner part, reaching downwards to the insertion of the pronator teres, and for- Overlying wards to the hollowed anterior surface. This supinator is altogether concealed at the posterior and external aspects of the limb by the muscles of the superficial layer; and an- and contiguous parts. teriorly the radial artery and nerve lie over it. The lower border is contiguous to the extensor ossis metacarpi pollicis, only the posterior interosseous artery intervening. Through the substance of the muscle the posterior interosseous nerve winds to the back of the limb. The upper part of the radius is surrounded by the fleshy fibres of the muscle, except at the tubercle and along a slip of bone beneath it.

Posterior interosseous artery The *posterior interosseous artery* is an offset from the common interosseous trunk (p. 304.), and reaches the back of the forearm above the ligament between the bones. Passing between the contiguous borders of the supinator brevis and the extensor ossis metacarpi, the artery descends is between the two layers of muscles. between the superficial and deep layers of muscles nearly to the wrist, where it ends by anastomosing with the carpal and anterior interosseous arteries. It furnishes many *muscular* offsets, and the following recurrent branch: —

Its re- The *recurrent* branch springs from the artery near its

commencement, and ascends through some fibres of the supinator, but beneath the anconeus, to supply the elbow joint, and to anastomose with a long branch of the superior profunda artery in the last named muscle. current branch.

The *posterior interosseous nerve* takes its origin from the musculo-spiral trunk in front of the outer condyle of the humerus, and winds backwards through the fibres of the supinator brevis. Escaped from the supinator, the nerve is placed between the superficial and deep layers of the muscles as far as the middle of the forearm. Much reduced in size at that spot, it sinks beneath the extensor of the second phalanx of the thumb, and runs on the interosseous membrane to the back of the carpus. Finally, the nerve enlarges beneath the tendons of the extensor communis digitorum, and terminates in filaments to the ligaments and the articulations of the carpus. Interosseous nerve. Position to muscles. Termination on back of the carpus.

Branches. — This nerve furnishes offsets to all the muscles of the deep layer; and to those of the superficial layer with the exception of these three, viz. the anconeus, the supinator longus, and the extensor carpi radialis longior. Its muscular offsets.

Radial Artery at the Wrist. — At the wrist the radial artery winds below the end of the radius to the back of the carpus, and enters the palm of the hand at the first interosseous space, between the heads of origin of the first dorsal interosseous muscle. At first the vessel lies deeply on the external lateral ligament of the wrist joint, and is beneath the tendons of the extensors of the metacarpal bone and first phalanx of the thumb; but afterwards it is more superficial and is crossed by the tendon of the extensor of the second phalanx of the thumb. Offsets of the external cutaneous nerve entwine around the artery. Its *branches* are numerous, but inconsiderable in size. Radial artery on back of wrist. Connections with parts around. Branches are small.

a. The *dorsal carpal branch* passes transversely beneath the extensor tendons, and forms an arch with the corresponding offset of the ulnar artery. From this arch branches descend to the third and fourth interosseous spaces, and constitute the *dorsal interosseous arteries.* To back of carpus.

b. The *metacarpal* or *first dorsal interosseous branch* reaches the space between the second and third metacarpal bones, and anastomoses, like the corresponding arteries of the other spaces, with a perforating branch of the deep palmar arch. Finally, it is continued to the cleft of the fingers, where it ends by joining the Metacarpal branch.

digital artery of the superficial palmar arch, and giving small dorsal branches to the index and middle fingers.

Dorsal arteries of the thumb

c. Two small *dorsal arteries of the thumb* arise opposite the metacarpal bone, along which they extend, one on each border, to be distributed on its posterior aspect.

and fore finger.

d. The *dorsal branch of the index finger* is distributed on the radial edge of the metacarpal bone of that digit.

Sheaths of the annular ligament are six.

Position from without inwards.

The different *compartments* of the *annular ligament* may be now seen more completely by dividing the sheaths of the ligament over the different tendons passing beneath. There are six different spaces, which are lubricated by synovial membranes. The most external one lodges the first two extensors of the thumb; the next is a large hollow for the two radial extensors of the wrist; and a very small space for the extensor of the second phalanx of the thumb follows on the ulnar side. Still to the inner side is the common sheath for the extensor of the fingers, and that of the fore finger; and there is a separate internal compartment for the extensor of the little finger. Internal to all is the space for the extensor carpi ulnaris. The last muscle grooves the ulna; but all the others, with the exception of the extensor minimi digiti which is between the bones, lie in hollows in the radius in the order mentioned above.

Bones grooved by the tendons.

To see supinator brevis,

Dissection.—If the supinator brevis be divided by a vertical incision, and raised from the radius, its attachment to the bone will be better seen.

interosseous nerve,

The posterior interosseous nerve, and the offsets from its gangliform enlargement, may be more completely traced after the tendons of the extensor of the fingers and indicator muscle have been cut at the wrist.

and interossei muscles.

The dorsal surface of the posterior interossei muscles of the hand may be cleaned, so that their double origin, and their insertion into the side and dorsum of the phalanges may be observed. Appearing between the heads of origin of these muscles are the posterior perforating arteries.

Section VII.

LIGAMENTS OF THE ELBOW, WRIST, AND HAND.

Directions.

Directions.—The ligaments of the remaining articulations of the limb may be examined at once if they are still moist,

but should any of them have become dry, these should be softened with a wet cloth whilst the others are being learnt.

Dissection. — To make the necessary dissection of the ligaments of the elbow joint, the brachialis anticus must be taken away from the front, and the triceps from the back of the joint; the muscles connected with the outer and inner condyles, as well as the supinator brevis and the flexor profundus, are to be removed. With a little cleaning, the four ligaments — anterior, posterior, and two lateral — will come into view.

Dissection of the elbow joint.

The interosseous membrane, between the bones of the forearm, will be prepared by the removal of the muscles on both the anterior and posterior aspects.

THE ELBOW JOINT.— In this articulation the lower end of the humerus is received into the hollow of the ulna, so as to produce a hinge-like arrangement; and the upper end of the radius assists to form part of the joint. Where the bones touch, the surfaces are covered with cartilage, and their articular ends are kept in place by the following ligaments: —

Bones forming the elbow joint.

The ligaments are

The *external lateral ligament* is a roundish fasciculus, which is attached by one end to the outer condyle of the humerus, and by the other to the orbicular ligament around the head of the radius. A few of the posterior fibres pass backwards to the external margin of the ulna.

Externa lateral.

The *internal lateral ligament* is triangular in shape: it is pointed at its upper extremity, and is connected to the inner condyle of the humerus. The fibres diverge as they descend, and are inserted in this way: — The anterior which are the strongest, are fixed to the inner edge of the coronoid process; the posterior are attached to the inner side of the olecranon; whilst the middle fibres join a transverse ligamentous band over the notch between the olecranon and the coronoid process. The ulnar nerve is in contact with this ligament; and some vessels enter the joint by an aperture beneath the transverse band.

Internal lateral is wide.

Inferior attachments.

A notch on inner side of the joint.

The *anterior ligament* is thin, and its fibres are separated by intervals in which masses of fat are lodged. By its upper margin the ligament is inserted into the front of the humerus, and by its lower margin into the anterior part of

Anterior ligament is thin.

the coronoid process and the orbicular ligament. The brachialis anticus muscle covers it.

Posterior ligament is weakest. The *posterior ligament* is thinner than the anterior, and is completely covered by the triceps muscle. Superiorly it is attached to the humerus above the fossa for the olecranon, and inferiorly it is inserted into the olecranon. Some few fibres are transverse between the margins of the fossa before mentioned.

Dissection. *Dissection.* — Open the joint by an incision across the front, near the humerus, and disarticulate the bones, in order that the form of the articular surfaces may be seen.

Synovial membrane. The *synovial membrane* lines the joint, and can be traced from one bone to another along the inner surface of the connecting ligaments. It projects between the radius and the orbicular ligament, and serves for the articulation of the head of that bone with the small sigmoid cavity of the ulna.

Lower end of the humerus. One surface for radius, *Articular surfaces of the bones.* — The humerus presents inferiorly two distinct articular surfaces for the bones of the forearm. The one for the radius is on the outer side, and consists of a rounded eminence (capitellum) on the front of the bone, which is covered with cartilage only on the anterior aspect: between it and the surface that corresponds to another for the ulna; the ulna is a slight hollow. The surface in contact with the ulna is limited internally and externally by a prominent ridge, and is hollowed out in the centre like a pulley (trochlea): the external ridge corresponds to the interval between the heads of the radius and ulna. also for coronoid process and radius, On the front of the humerus, above the articular surface, are two depressions that receive the coronoid process and the head of the radius during flexure of the joint; and olecranon. and on the posterior aspect is a large fossa for the reception of the olecranon in extension of the forearm.

End of the ulna. On the end of the ulna there is a large excavation named sigmoid cavity, which is narrow in the centre, but expanded in front and behind. A slightly raised line extends from front to back through the cavity, which is received into the hollow of the trochlea of the humerus in the motions of the joint. In the bottom of the cavity the cartilage is wanting completely, or for a greater or smaller distance across the articular hollow.

End of The end of the radius presents a circular depression with

a raised margin. In the bent state of the joint the depression of the radius is fitted on the eminence of the humerus, and the bone is thus supported during rotation of the limb. the radius.

Union of the Radius and Ulna. — The radius is connected with the ulna, at both the upper and lower ends, by means of distinct ligaments and a synovial membrane; and the shafts of the bones are further united by an interosseous ligament. Radius is joined to ulna.

Upper radio-ulnar articulation. — In this joint the head of the radius is received into the small sigmoid cavity of the ulna, and is kept in place by the following ligamentous band: — At the upper end by

The *annular* or *orbicular ligament* is a strong fasciculus of fibres, about a quarter of an inch wide, which is placed around the prominence of the head of the radius, and is attached to the anterior and posterior edges of the small sigmoid cavity of the ulna. Its upper border is connected with the ligaments of the elbow joint; but the lower is free, and is applied around the neck of the radius. The radius moves freely in the socket formed by the ligament and the cavity of the ulna. orbicular ligament around the head of the bone,

The *synovial membrane* is a prolongation of that lining the elbow joint; it projects inferiorly between the neck of the radius and the lower margin of the annular ligament. and synovial membrane.

Shafts of the bones. — The aponeurotic stratum connecting together the bones in nearly their whole length consists of the two following parts: — Union of the shafts.

The *interosseous membrane* is a thin fibrous layer, which is attached to the contiguous margins of the radius and ulna, and forms an incomplete septum between the muscles on the front and back of the forearm. Superiorly the membrane is wanting for a considerable space, and through the interval the posterior interosseous vessels pass backwards. Some small apertures exist in it for the passage of vessels; and the largest of these is about two inches from the lower end, through which the anterior interosseous artery turns to the back of the wrist. The membrane gives attachment to the deep muscles. Most of its fibres are directed obliquely inwards towards the ulna, though a few on the posterior surface have an opposite direction. Radius is joined in the middle by interosseous membrane. This is deficient above.

The *round ligament* is a slender band above the inter- By round

liga- ment. osseous membrane, whose fibres have a direction opposite to those of the membrane. By one end it is fixed to the front of the coronoid process, and by the other it is inserted into the radius below the tubercle. This ligament divides the space above the interosseous membrane into two parts. Oftentimes this band is not to be recognised.

The lower end after. The lower radio-ulnar articulation cannot be well seen till after the examination of the wrist joint.

Dissection. *Dissection.* — To see the ligaments of the wrist joint, the tendons and the annular ligaments must be removed from both the front and back; and the fibrous structures and the small vessels must be cleaned away carefully from the surface of the ligaments.

Bones forming wrist united by THE WRIST JOINT. — The lower end of the radius and the first row of the carpal bones enter into the wrist joint; and four ligaments maintain in contact the osseous surfaces, viz. anterior and posterior, and two lateral. The ulna is shut out from this articulation by means of a piece of fibro-cartilage.

external lateral, The *external lateral ligament* is a short and strong band, that intervenes between the styloid process of the radius and the upper part of the scaphoid bone.

internal lateral, The *internal lateral ligament* is smaller than the external, but is longer than it. It is attached by one end to the styloid process of the ulna, and by the other to the rough, upper part of the cuneiform bone. Some of the anterior fibres are continued to the pisiform bone.

anterior and The *anterior ligament* takes origin from the end of the radius, and is inserted into the first row of carpal bones at the anterior surface, except the os pisiforme.

posterior ligament. The *posterior ligament* is membranous, like the anterior, and its fibres are directed downwards and inwards. Superiorly it is attached to the lower end of the radius, and inferiorly it is fixed, after the manner of the anterior ligament, to the first row of carpal bones on the posterior aspect.

Dissection. *Dissection.* — To see the form of the articulating surfaces, the joint may be opened by a transverse incision through the posterior ligament, near the bones of the carpus.

Surface of radius. *Articular surfaces.* — The end of the radius, and the fibro-cartilage uniting it with the ulna, form an arch for the reception of the carpal bones; and the surface of the radius

is divided by a prominent line into an external triangular, and an internal square impression. The three bones of the first carpal row constitute a convex eminence, which is received into the hollow before mentioned, and the different surfaces of both touch in this way; — the scaphoid bone corresponds to the external mark of the radius, the semilunar bone to the square impression, and the cuneiform bone is in contact with the triangular fibro-cartilage. Of first row of carpal bones.

The *synovial membrane* has the arrangement common to simple joints. This joint sometimes communicates with the lower radio-ulnar articulation by means of an aperture in the fibro-cartilage separating the two. Synovial sac.

Lower Radio-ulnar Articulation. — In this articulation the convexity of the end of the ulna is received into a concavity on the radius; — an arrangement just the opposite to that which exists between the upper ends of the bones. The chief bond of union between the bones is a strong fibro-cartilage; but a kind of capsule, consisting of scattered fibres, surrounds loosely the end of the ulna. Lower ends of radius and ulna joined by capsule

The *triangular fibro-cartilage* is placed transversely beneath the end of the ulna, and is thickest at its margins and apex. By its base the cartilage is fixed to the ridge which separates the carpal from the ulnar articulating surface of the radius; and by its apex to the styloid process of the ulna, and to the depression at the root of that process. Its margins are united with the contiguous anterior and posterior ligaments of the wrist joint; and its surfaces enter into the construction of different joints, viz. those of the wrist and lower radio-ulnar articulation. Occasionally it is perforated by an aperture. triangular fibro-cartilage. Attachments and connections.

The *synovial membrane* (membrana sacciformis) is very loose, from which circumstance it has received its name, and ascends between the radius and the ulna: it is separated from that of the wrist joint by the triangular fibro-cartilage. Synovial membrane.

Dissection. — The articulation of the carpal bones will be prepared by taking away all the tendons from the hand, and cleaning carefully the surface of the connecting ligamentous bands between the several bones. To the pisiform bone there are distinct ligaments. Dissection of carpal

At the same time, the ligamentous bands uniting the meta- and me-

tacarpal joints. carpal with the carpal bones and with one another, should be dissected.

Bones are joined into two rows. UNION OF THE CARPAL BONES. — The several bones of the carpus are united into two rows by dorsal, palmar and interosseous bands; and the two rows are connected one to another by separate ligaments.

How first row is formed. *Bones of the first row.* — The os semilunare is united to the contiguous bones, viz. the scaphoid and cuneiform, by a *dorsal* and a *palmar* transverse band, as well as by an *interosseous* ligament at the upper part of the contiguous surfaces. Separate ligaments of pisiform bone. The pisiform bone is articulated to the front of the cuneiform bone by a distinct *capsule* and a *synovial* membrane: it has further two special ligaments; — one of these is attached to the process of the unciform bone, and the other to the base of the fifth metacarpal bone.

Second row is like first. The *bones of the second row* are connected together in the same way as those of the first row, viz. by a *dorsal* and a *palmar* band of fibres from one bone to another. Between the contiguous rough surfaces of the several bones are *interosseous* ligaments, one to each interval.

The two rows are joined by *One row with another.* — The two rows of carpal bones are connected by an anterior and posterior, and two lateral ligaments.

anterior, The *anterior* ligament consists of irregular fibres, and intervenes between the two rows on the palmar aspect. The posterior, *posterior* ligament, which is longer and looser, and the greater number of whose fibres are transverse, has a corresponding attachment on the dorsal aspect of the bones. and lateral ligaments. Of the *lateral ligaments*, the external is the best marked, and extends between the os trapezium and the scaphoid bone; whilst the internal ligament passes between the cuneiform and unciform bones.

Dissection. *Dissection.* — After the division of the lateral and posterior ligaments, the one row of bones may be separated from the other, so as to allow the articular surfaces to be seen.

Surface of each row in contact. *Articular surfaces.* — The first row of carpal bones forms an arch, whose hollow is turned towards the other. In the second row, the os magnum and os unciforme present a condyloid projection, which is received into the arch before mentioned: whilst the two outer bones are much below the

level of the others, and form a slight hollow for the reception of the outer part of the scaphoid bone.

One *synovial membrane* serves for the articulation of all the carpal bones, except that of the pisiform with the cuneiform bone. Serving for the joint between the two rows of the carpus, the membrane sends upwards and downwards prolongations between the individual bones. The offsets upwards are two, and they sometimes join the synovial membrane of the wrist joint; but the offsets in the opposite direction are three, and may be continued to all, or only some of the articulations between the four inner metacarpal with their carpal bones. One synovial membrane for all the carpal bones, and four inner metacarpal.

Union of the Metacarpal Bones. — The metacarpal bones of the four fingers are connected at their bases by the following ligaments: — Superficial *dorsal* and *palmar* fasciculi of fibres pass transversely from one bone to that next it; and those in the palm are the strongest. Besides, there are short *interosseous* bands between the contiguous rough surfaces of the bones. Metacarpal bones are joined by their bases

At their anterior extremities the metacarpal bones are bound together by the *transverse ligament*, which has been examined in the dissection of the hand (p. 318.). and by their heads.

Union between the Metacarpal and Carpal Bones. — Most of the metacarpal bones of the fingers are articulated with the carpal bones after one plan. The bone of the thumb has a separate joint with a synovial membrane. Joint between carpal and metacarpal bones;

a. The *metacarpal bone of the thumb* articulates with the os trapezium; and the ends of the bones are encased in a separate capsular ligament. The joint is supplied with a *synovial* membrane, which is simple in its arrangement. that of the thumb;

b. The *metacarpal bones of the fingers* receive longitudinal bands from the carpal bones on both aspects, thus: — those of other fingers

The *dorsal ligaments* are two to each of the four, except that of the little finger. The bands to the metacarpal bone of the fore finger come from the os trapezium and os trapezoides; those to the third bone are from the os magnum and os trapezoides; those to the bone of the ring finger from the os magnum and os unciforme; and to the fifth metacarpal bone there is but one band from the unciform bone. The *palmar ligaments* are weaker and less constant than the dorsal. There is one to each metacarpal bone, except that of through dorsal and palmar bands

the little finger: they may be oblique in direction; and a band may be divided between two bones, as in the case of the ligament that is attached to the os trapezium and the second and third metacarpals. Sometimes one or more may be wanting.

Lateral band.

On the ulnar side of the metacarpal bone of the middle finger is a longitudinal or *lateral band*, which is attached above to the os magnum and os unciforme, and below to the rough ulnar side of the base of the above-mentioned metacarpal bone. Sometimes this band isolates the articulation of the last two metacarpals with the unciform bone from the remaining carpo-metacarpal joint; but more frequently it is divided into two parts, and does not form a complete partition between those joints.

How seen.

This band may be seen by opening the articulation between the unciform and the last two metacarpal bones; and then cutting through, with care, the transverse ligaments joining the third and fourth bones, so as to allow the separation of the fourth from the third metacarpal.

Dissection.

Dissection.—The articulating surfaces of the bones in the carpo-metacarpal articulation may be seen by cutting through the rest of the ligaments on the posterior aspect of the hand.

Surface of the ends of the bones.

Articular surfaces.—The metacarpal bone of the fore-finger presents a hollowed articular surface, which receives the prominence of the os trapezoides, and articulates laterally with the os trapezium and os magnum. That of the middle finger articulates with the os magnum. But the metacarpal bones of the ring and little finger are opposed to the unciform bone, and do not reach so far back as the other two.

Synovial sacs two or three.

Synovial membranes.—Usually two synovial membranes are interposed between the carpal and metacarpal bones, viz. a separate one for the bone of the thumb, and offsets of the common carpal synovial sac (p. 335.) for the others. Sometimes there is a distinct sac for the articulation of the os unciforme with its metacarpals.

Inter-osseous ligaments of metacarpal bones,

Interosseous ligaments.—The interosseous ligaments between the bases of the metacarpal bones may be demonstrated by detaching one bone from another. On forcibly separating the carpal bones, their strong interosseous ligaments will also

appear, viz. one on each side of the os semilunare in the first row, and between all in the second row. carpal.

Lateral union. — Where the metacarpal bones touch they are covered by articular cartilage, and the surfaces are furnished with prolongations of the same synovial membrane that serves for their articulation with the carpus. Side union.

Dissection. — For the examination of the joint between the head of the metacarpal bone and the first phalanx of the finger, it will be requisite that the tendons and the tendinous expansion around it should be cleared away. A lateral ligament on each side, and an inferior thick band are to be defined. Another joint may be opened to see the articular surfaces. Dissection of finger joints.

The same dissection may be made for the articulations between the phalanges of the finger.

UNION BETWEEN THE METACARPAL BONES AND THE FIRST PHALANGES. — In these joints the convex head of the metacarpal bone is received into the glenoid fossa of the phalanx, and the two are retained in contact by the extensor and flexor tendons, and the following ligaments: — Metacarpal bones and phalanges.

The *lateral ligaments* are the same on both sides of the joint. Each is triangular in form; it is attached by its upper part to the tubercle on the side of the head of the metacarpal bone, and ends below by being inserted into the side of the phalanx and the inferior ligament. Lateral ligaments. The *inferior ligament* is a longitudinal band, which is fixed firmly to the phalanx, but loosely to the metacarpal bone. It is fibro-cartilaginous in texture, and is grooved for the flexor tendon: to its sides the lateral ligaments are attached. Inferior ligament.

Covering the upper part of the joint is the extensor tendon; this takes the place of a superior ligament, and sends down an expansion on each side which serves as a capsule to the joint. Capsule. The *synovial* membrane of the joint is a simple sac. Synovial membrane.

In the articulation of the thumb two sesamoid bones are connected with the inferior ligament, and receive most of the fibres of the lateral ligaments. Joint of thumb.

UNION OF THE PHALANGES. — The ligaments of the first joint are similar to those in the metacarpo-phalangeal articulation, viz. two lateral and an inferior. Joints of the phalanges have

lateral and inferior ligament.

The *lateral ligaments* are triangular in form ; each is connected by its apex to the side of the phalanx near the anterior part, and by its base, to the inferior ligament. The *inferior ligament* has the same mode of attachment between the extremities of the bones as in the metacarpo-phalangeal joint, but it is not so strong as in that articulation. There is a simple *synovial membrane* present in the joint.

The articulation of the second with the last phalanx is like the preceding joint, both in the number and disposition of its ligaments, and in the surfaces of the bones ; but all the articular parts are much less strongly marked.

Surface of the bones.

Articular Surfaces. — The anterior end of each phalanx is marked by a pulley-like surface. The posterior end of the phalanx presents a transversely hollowed fossa, and is provided with a crest which fits into the central depression of the opposite articular surface in the movements of the joint.

TABLE OF THE CHIEF ARTERIES OF THE UPPER LIMB.

The subclavian is continued in the arm by

- 1. Axillary artery
  - Superior thoracic
  - acromial thoracic
    - Muscular
    - inferior acromial
    - humeral thoracic.
  - long thoracic
  - alar thoracic
  - subscapular
    - Dorsal artery
      - Infrascapular.
    - muscular.
  - anterior circumflex
  - posterior circumflex.
- 2. brachial artery
  - To coraco-brachialis
  - superior profunda
    - Muscular to triceps and anconeus
    - anastomotic.
  - nutritious
  - inferior profunda
    - Muscular to triceps
    - anastomotic.
  - anastomotic
  - muscular.
- 3. radial artery
  - Recurrent
  - muscular
  - superficial volar
  - posterior carpal
  - anterior carpal
  - metacarpal
  - dorsal of the thumb
  - of the index finger
  - princeps pollicis
  - radialis indicis
  - deep arch
    - Recurrent
    - perforating
    - interosseous
    - communicating.
- 4. ulnar artery
  - Anterior recurrent
  - posterior recurrent
  - interosseous
    - Anterior
      - Nutritious
      - muscular.
    - posterior
      - Recurrent
      - muscular
  - muscular
  - dorsal of the hand, or metacarpal
    - Dorsal carpal
    - metacarpal or interosseous.
  - anterior carpal
  - superficial arch
    - Communicating
    - four digital branches
    - cutaneous
    - muscular.

TABLE OF THE SPINAL NERVES OF THE UPPER LIMB.

Brachial Plexus gives off below the clavicle -

- Anterior thoracic - -
  - Superficial
  - deep.
- subscapular - - -
  - Superior
  - inferior
  - long.
- circumflex - - -
  - Articular
  - cutaneous
  - to teres minor
  - to deltoid.
- nerve of Wrisberg
- internal cutaneous - -
  - Small cutaneous
  - anterior of forearm
  - posterior of forearm.
- musculo-cutaneous - -
  - To coraco-brachialis
  - biceps and
  - brachialis anticus
  - cutaneous external of fore-arm
  - articular to carpus.
- mediar - -
  - To pronator teres
  - to muscles of forearm, except flexor ulnaris and part of profundus
  - anterior interosseous
  - cutaneous palmar
  - to muscles of thumb in part
  - five digital branches.
- ulnar - - - -
  - Articular to elbow
  - to flexor carpi ulnaris
  - to flexor profundus in part
  - cutaneous branch of forearm and palm
  - dorsal cutaneous of the hand
  - superficial palmar division
    - Communicating
    - two digital branches.
  - deep palmar nerve.
- musculo-spiral - -
  - Internal cutaneous
  - to triceps
  - and anconeus
  - external cutaneous
  - to supinator and extensor radialis longus
  - posterior interosseous -
    - Muscular
    - articular.
  - radial - - - -
    - Cutaneous of back of thumb and of first two fingers and half the next.

CHAPTER IV.

DISSECTION OF THE THORAX.

Section I.

CAVITY OF THE THORAX.

The cavity of the thorax is the space included by the spinal column, the ribs, and the sternum, and by certain muscles that close the intervals between the pieces of the bony framework. In it the organs of respiration, and the heart with its great vessels are lodged; and through it the gullet, and some nerves and vessels are transmitted. Definition. Contents.

Dissection.— When the parts that cover in front the bony parietes of the thorax have been examined and taken away, the cavity is to be opened by removing a part of the anterior boundary. To make a sufficient opening into the thorax, the sternum is to be sawn through opposite the interval between the first two ribs, and again between the insertion of the cartilages of the fifth and sixth ribs. After detaching the lining membrane (pleura) from the inner surface of the chest, the student is to cut through all the true ribs except the first and seventh *, as far back as he can conveniently reach. The loose sternum and the ribs can be removed, by dividing the intercostal muscles in the first and sixth spaces. The internal mammary artery may now be cut across, and the bag of the pleura opened: when this has been done, the cavity with its contents will be ready for examination. Dissection to open thorax.

The sternum and the cartilages of the ribs will be required hereafter for the dissection of the ligaments. Sternum to be kept.

Form. — The cavity is of the same general form as the thorax, that is to say, irregularly conical, with the apex Form in general.

* The student must be mindful to leave those ribs uncut: the division of them will not be advantageous to his own part, and will interfere with the dissection of the neck and abdomen.

above and the base downwards; and it appears, from the collapsed state of the lungs, to be only partly filled by the contained viscera, but during life the whole of the now vacant space is occupied by the expanded lungs. On a horizontal section its shape would appear somewhat cordiform; for the cavity is flattened on the sides, is diminished behind by the prominent spinal column, and is projected backwards on each side of the spine.

On a cross section.

Boundaries. — The enclosing parts consist of the bones of the trunk, with certain accessory muscles, both laterally and above and below, as in the following enumeration.

Parts bounding it

On the sides the ribs with their intercostal muscles form the wall; whilst in front is the sternum, and behind is the spine, together with the muscles that are respectively contiguous to the middle line.

on sides, in front, behind.

The base is constructed at the circumference by the last dorsal vertebra behind, by the end of the sternum before, and by the ribs on the side; and within the bony scaffolding the fleshy diaphragm fills the space. The base is wider transversely than from front to back, and is on the whole convex towards the chest, though a closer inspection will show an undulating surface, and a different level at different points. Thus in the centre it is lower than at the sides, and is on a level with the xiphoid cartilage. On the right side it rises to a level with the upper border of the fifth rib near the sternum; and on the left, only to the corresponding part of the upper border of the sixth rib.* From these lateral projections, the diaphragm slopes suddenly towards its attachment to the ribs, but more behind than before, so as to leave a narrow interval between it and the wall of the chest. The level of this attached part will correspond to an oblique line over the side of the chest from the xiphoid cartilage to the eleventh rib; but it differs slightly on the two sides, being rather lower on the left.

The base, its level, formed by diaphragm. Its surface and height.

The apex is continued higher than the osseous part of the wall, and reaches into the root of the neck. And the highest point is not in the centre of the space, for there the

Apex reaches into neck,

* This is the height in the dead body. The level to which it may reach in great respiratory efforts during life will be stated with the account of the Diaphragm.

windpipe, bloodvessels, &c. lie; but is prolonged on each side for an inch or an inch and a half above the first rib, so that the apex may be said to be bifid. Each point projects between the scaleni muscles, and touches the subclavian bloodvessels. In the interval between the apices are the several parts that pass between the neck and the thorax. is bifid, how bounded.

Dimensions.—The hollow of the thoracic cavity does not correspond to the visible size of the thorax; for about the lower half of the space included by the ribs is occupied by the abdominal viscera, and, above, it reaches beyond the ribs into the neck. Size of chest not that of cavity;

In consequence of the arched condition of the diaphragm the depth of the space must vary greatly at different points. At the centre, where the depth is least, it measures about seven inches, but at the back as much again; and the other vertical measurements can be estimated by means of the data given with respect to the correspondence of the base to parts of the wall of the thorax. depth varies; before; behind; on sides.

Alterations in capacity.— The size of the thoracic cavity is constantly varying during life with the condition of the ribs and the diaphragm in breathing. Size is altered in life;

It is increased in the horizontal measurements in inspiration, when the ribs are raised and separated from one another; and is diminished in expiration as the ribs approach one another, and the sternum sinks. in transverse dimensions by ribs;

An alteration in depth is due to the condition of the diaphragm in respiration; for the muscle descends when air is taken into the lungs, thus increasing the cavity; and ascends when the air is expelled from those organs, so as to restore the previous size of the space, or in violent efforts to diminish it. But the movement of the diaphragm is not equal throughout, and some parts of the cavity will be increased proportionally more than others. For instance the central tendinous piece is joined to the heart case, and moves but slightly; but the lateral, bulging, fleshy halves descend freely, and add greatly to the size of the lateral part of the chest by their separation from the thoracic parietes. in depth by the diaphragm, but unequally;

It is evident that the thoracic cavity may be diminished by the base being pushed upwards by enlargement, either temporary or permanent, of the viscera in the upper part of thorax lessened by additions to abdomen.

the abdomen; or by the existence of fluid in the latter cavity.

THE PLEURÆ.

Sac of the pleura.

The pleuræ are two serous membranes, or closed sacs, which are reflected around the lungs in the cavity of the thorax. One occupies the right, and the other the left half of the cavity; each is restricted to its own side, but it approaches its fellow along the middle line of the body, forming a thoracic partition, though the two do not communicate.

Form.

Taking the form of the thorax, each pleura is a sac of a conical shape, whose apex projects into the neck above the first rib, and whose base is in contact with the diaphragm.

Outer surface.

Its outer surface is rough, and is connected to the lung and the wall of the chest by connective tissue, but its inner

Inner surface.

surface is smooth and secerning.

Disposition in thorax.

Surrounding the lung, and lining the interior of one half of the cavity, the serous membrane consists of a parietal part or the pleura costalis, and of a visceral part, the pleura pulmonalis. The bags of the pleuræ approach one another in the middle line, as before said, and form a partition called mediastinum between the two sides of the cavity of the chest.

Difference in sac of right and left side.

There are some differences in the shape and the extent of the two pleural bags. On the right side the bag is wider and shorter than on the left; and the latter is narrowed by the projection of the heart to the left side.

The sac is continuous over lung.

The continuity of the bag of the pleura over the lung, and along the wall of the chest, may be traced circularly from a given point to the same, in the following manner:—

The continuity is here traced.

Supposing the membrane to be followed outwards from the sternum, it may be perceived on the walls of the chest as far as the spinal column; here it is directed forwards to the root of the lung, and is reflected over the lung, covering its surface, and connecting together its different lobules. From the front of the root of the lung, the pleura may be seen to course over the side of the pericardium to the sternum. If the serous sac be traced above the root of the lung, it will be found to describe a circle without deflection over the viscus. Below the root the pleura gives rise to a thin fold, the ligamentum latum pulmonis, which intervenes between

the inner surface of the lung and the side of the pericardium.

The mediastinum. — The thoracic partition, or the mediastinum, is formed by the approximation of the pleural bags along the middle line, and is constructed of two layers of membrane, — one being derived from each sac. But the two strata do not approach equally closely throughout; for about midway between the sternum and the spine they are widely separated from one another by the heart. In front of the heart and behind it, however, the contiguous strata of the mediastinum may be distinctly seen near one another; and to these portions the terms "anterior and posterior mediastina" are sometimes applied, but it should not be forgotten that they are only parts of one great mediastinum or septum reaching from the sternum to the spine.

Along middle of chest the sacs form a partition; their arrangement.

The *part in front of the heart* (anterior mediastinum) extends from the pericardium to the back of the sternum, and is formed by the pleural bag of each side. Behind the second piece of the sternum the bags touch one another, but above and below that spot they are separated by an interval. This interpleural space in the anterior part of the mediastinum is narrowed at the centre, and is inclined below to the left of the middle line. In the upper part of the space are the remains of the thymus gland, and the origin of some of the hyoid and laryngeal muscles; and in the lower part is some connective tissue, together with the triangularis sterni muscle of the left side.

Part of septum in front of the heart encloses a space of hour-glass shape.

The *part behind the heart* (posterior mediastinum) intervenes between the back of the pericardium with the roots of the lungs, and the spinal column. Its lateral boundaries are the opposite pleural sacs, which are separated here by a larger interpleural space than in the front of the heart. If the pleura be divided behind the lung on the right side, the extent of the space will appear. In this space are contained the different bodies on the front of the spine, which pass through or out of the thoracic cavity, viz. the aorta, the vena azygos and the thoracic duct, the œsophagus with its nerves, the trachea, the splanchnic nerves at the lower part, and some lymphatic glands.

Part behind heart encloses a larger space.

The contents of the space.

Dissection. — The pleura and the fat are now to be cleaned from the side of the pericardium; and the root of the lung

Clean the root of the

lung. is to be dissected out by taking away the pleura and the connective tissue from its front and back, without injuring its several vessels. In this dissection the phrenic artery and nerve will be found in front of the root, together with a few nerves (anterior pulmonary); the last are best seen on the left side. Behind the root of the lung is the large vagus nerve. For the present, the arch of the aorta and the small nerves on it may be left untouched.

Trace the nerves.

CONNECTIONS OF THE LUNG.

Number and use. The lungs are two in number, and are contained in the cavity of the thorax, one on each side of the spinal column. In these organs the blood is changed in respiration.

Form. The lung is of a somewhat conical form, corresponding to the shape of the half of the chest in which it is lodged, and is unattached on all sides, except at the inner part where the vessels enter and form its root. It is covered, as before said, by the bag of the pleura, except at the root. From the irregularity of its shape, it presents for examination a base and apex, two borders, and two surfaces; it is also divided into lobes by fissures, and has a root composed of the vessels and nerves entering its inner surface.

Base touches diaphragm. The base of the lung is hollowed, and fits on the convexity of the diaphragm; at its circumference is a thinned part, that projects into the narrow space between that muscle and the thoracic wall. Following the shape of that muscle, it is sloped obliquely from before backwards, and in consequence reaches much lower at the posterior than at the anterior edge. Its position with respect to the wall of the thorax may be ascertained externally by taking the levels of the diaphragm as guides (p. 342.); and it must be remembered that the lung will be a rib's breadth lower in front on the left, than on the right side. The apex is rounded, and projects an inch to an inch and a half above the first rib, where it lies beneath the clavicle, the anterior scalenus muscle, and the subclavian artery.

Shape and level.

Apex is in the neck.

Anterior edge is thin. The anterior edge or border is thin, and overlays in part the pericardium. On the right side it lies along the middle of the sternum as low as the sixth costal cartilage. On the left side it is in contact with its fellow, only pleura being

Position on right and left side.

between, as low as the fourth costal cartilage; but below that spot it presents a V-shaped notch, whose apex is opposite the outer part of the cartilage of the fifth rib, and whose ase is turned to the middle line. Two fissures are seen in this border of the right lung, but only one in that of the left lung. The posterior border is as long again as the anterior, and projects inferiorly between the lower ribs and the diaphragm; it is thick and vertical, and is received into the hollow by the side of the spinal column.

Posterior edge is thick.

On the outer aspect the lung is convex, and is in contact with the wall of the thorax. A large cleft divides this surface into two pieces (lobes of the lung), and on the right side there is a second smaller fissure. The inner surface is flat when compared with the outer, and is marked by the following inequalities: — Altogether in front, is the hollow corresponding to the heart and its large vessels, which is greatest on the left lung; behind this, but nearer the posterior than the anterior border, is a fissure about three inches long (hilum pulmonis), which receives the vessels forming the root of the lung.

External surface.

Internal surface

gives attachment to the root.

Each lung is divided incompletely into two parts or lobes by an oblique fissure, which begins near the apex, and ends in the anterior border near the base. From the form of the lung and the direction of the fissure, the lower lobe is necessarily the largest. In the right lung a second horizontal fissure is directed forwards, from the middle of the oblique one, to the anterior border, and cuts off a small triangular piece from the upper lobe: this is the third lobe of that lung. Occasionally there may be a trace of the third lobe in the left lung.

Division into lobes.

Left has two,

and the right three lobes.

Besides the difference in the number of the lobes, the right lung is larger and heavier, and is wider and more hollowed out at the base than the left; it is also shorter by an inch. The increased length and the narrowness of the left lung are due to the absence below of a large projecting body like the liver, and to the direction of the heart to the left more than to the right side.

Difference in form and size of the lungs.

Root of the lung. — The vessels of the lung entering the fissure on the inner surface are bound together by the pleura and some connective tissue; they form a foot-stalk or the root, which fixes the lung to the heart and the windpipe.

Root of lung.

Situation. The root is situate at the inner surface, about midway between the base and apex, and about a third of the breadth of that surface from the posterior border of the lung. In front of the root, on both sides, are the phrenic nerve and the anterior pulmonic nerves, the former being at some little distance from it; and anterior to the right root is the descending cava. Behind, on both sides, is the posterior pulmonic plexus; and on the left side there is, in addition, the descending aorta. Above, on the right side, is the vena azygos, and on the left side the arch of the aorta. Below each root is the fold of pleura called ligamentum latum pulmonis.

Connections.

Constituents of the root; In the root of the lung are found the vessels connected with the function of respiration, viz. a division of the air tube (bronchus), a branch of the pulmonary artery, and two pulmonary veins; together with small nutritive bronchial arteries and veins, and some nerves and lymphatics. These different bodies have the following position to one another: —

their relative position. On both sides the bronchus is most posterior, the pulmonary veins most anterior, and the pulmonary artery between the other two. In the direction from above downwards the position on the right side is, bronchus, pulmonary artery, and pulmonary veins; but on the left side there is a slight difference, owing to the bronchus and artery having changed places; consequently the relative position will there be, artery, bronchus, and veins. This difference in the two sides may be accounted for by the fact of the left branch of the air tube being at a lower level than the right one.

THE PERICARDIUM.

Situation. The bag that contains the heart is named the pericardium. It is situate in the middle of the thorax, in the interval between the pleuræ of opposite sides. Before proceeding with the anatomy of this sac, the following dissection should be undertaken: —

Clean vessels of heart and seek small nerves crossing *Dissection.*— Supposing the surface of the pericardium to be already cleaned, the student should next dissect out the large arteries and veins connected with the heart. He should afterwards seek carefully the following nerves of the

left side, that cross the arch of the aorta : — the nerve most to the left, and the largest, is the vagus ; that to the right of the vagus, the next largest in size, is the phrenic nerve. Between the preceding, and close to the coats of the artery, are the two following small nerves, the left superficial cardiac nerve of the sympathetic, and the cardiac branch of the left vagus ; of the two, the last is the smallest, and to the right of the other. arch of aorta.

The two cardiac nerves from the left vagus and the sympathetic are to be followed onwards to a small plexus (superficial cardiac) in the concavity of the aorta. An offset of the plexus is to be traced downwards between the pulmonary artery and the aorta, towards the anterior coronary artery of the heart ; and another prolongation is to be found coming forwards by the side of the arterial duct, from the deep cardiac plexus, to join the superficial one. When the pericardium is opened, the nerves will be followed on the heart, but their dissection is difficult, and will require some care. Oftentimes these small nerves are destroyed in injecting the body. Dissect superficial plexus in arch of aorta.

The *pericardium* is larger than the viscus it contains. Occupying the interpleural space, it is situate behind the sternum, and projects below on each side of that bone, but much more towards the left than the right side. Somewhat conical in form, the wider part of the bag is turned towards the diaphragm, and the narrower part upwards towards the large vessels of the heart. Laterally, the pericardium is covered by the pleura, and the phrenic nerve and vessels lie in contact with it. Its anterior and posterior surfaces correspond to the objects contained in the fore and hinder part of the interpleural space ; and on the anterior aspect the bag is partly covered by the margins of the lungs, especially the left, in the manner stated. This envelope of the heart consists of a fibrous structure, which is lined internally by a serous membrane. Connections of the pericardium. Fibro-serous case.

The *fibrous* part surrounds the heart entirely, and is pierced by the different vessels entering that organ. It gives prolongations around the vessels that pass through it, and the strongest of these sheaths is that on the aorta. Inferiorly it is united by fibres to the central tendon of the diaphragm ; but on the left side it extends beyond the limit Fibrous part gives sheaths to vessels. Joins diaphragm

Its structure. of that tendon, and reaches the fleshy fibres. This membrane is thickest at the upper part, and is formed of fibres that cross in different directions, many being longitudinal. When the pericardium has been cut open, the serous lining will be discernible.

Serous layer lines fibrous, The *serous sac* lines the interior of the fibrous pericardium, and is reflected over the surface of the heart. Like other serous membranes, the arachnoid for example, it has a parietal and a visceral part. After lining the interior of the fibrous case, to which it gives the shining appearance, and covers surface of heart. the membrane is conducted to the surface of the heart by the different vessels. As it is reflected on the aorta and the pulmonary artery, it contains those vessels in one tube, not Peculiarities in its reflections. passing between their contiguous surfaces; and at the posterior part of the pericardium it forms a pouch between the pulmonary veins of opposite sides. The cavity of the serous sac is lubricated by a little fluid.

Vessels. The *vessels* of the pericardium are derived from the internal mammary, the bronchial, the œsophageal, and the phrenic arteries.

THE HEART AND ITS LARGE VESSELS.

This hollow body is centre of circulation. The heart is a hollow muscular body, and is divided into four compartments by septa. It is the centre of the vascular system, and the agent in the propulsion of the blood through the body. Into it all veins enter, and from it the arteries issue.

Form. *Form.* — When the heart is distended, its form is rather conical; and it lies in the chest with the wider part, or the base directed upwards and to the right, and the rounded apex forwards and to the left side of the cavity. It is Surfaces and borders. rather flattened from before backwards, and rounded on the left side, so that the surfaces and borders have differences which serve to distinguish them one from another: — thus the anterior surface is slightly convex, whilst the posterior is nearly flat; the left border is thick and round, but the right is thin, sharp, and less firm.

Size. *Size.* — The size varies greatly, and in general the heart of the woman is smaller than that of the man. The measurements may be said to be, commonly, four inches and

three quarters in length, three inches and a half in width, and two inches and a half in thickness.

Position and direction. — The heart lies beneath the lower two thirds of the sternum, and projects on each side of it, but more on the left than the right side. The axis is not parallel to that of the body, but is inclined obliquely across it; and its left margin is undermost, whilst the right is foremost. Situation in the chest; line of its axis

The heart has not a vertical direction in the chest, with the base upwards and the apex down, but almost a horizontal one, so that the base is directed backwards to the right, and the apex forwards to the left side. placed almost horizontally.

Limits. — The limits of the whole heart are the following: — Limits

The base is opposite the spinal column, and corresponds to the interval between the fifth and the eighth dorsal vertebræ. The apex strikes the wall of the thorax during life just below the fifth rib, near its junction with the cartilage, and at a spot on the surface, "two inches below the nipple and one on the sternal side" (Williams). of base and apex,

The upper limit would be a line across the sternum on a level with the upper border of the third costal cartilage. And the lower limit, a line across the sternum at the junction of the xiphoid cartilage, from the articulations of the sixth and seventh cartilages of the right side to the spot where the apex touches. of upper margin, lower border.

Its lateral limits are the following. On the right it projects from one to one inch and a half beyond the middle line of the sternum, and its increase in this direction is constantly varying with the degree of distension of the right half of the heart. On the left side the heart projects three inches to three inches and a half from the centre of the sternum.

Position to wall. — In consequence of the direction of the heart in the thorax, only some parts can be near, or in contact with the parietes in front: thus the base must be directed away from the sternum and the costal cartilages; and the left half will be undermost and deep in the cavity, whilst the right half will be forwards and in contact largely with the anterior wall.* Only some parts touch the wall.

* If the dissector wishes for farther information respecting the cor-

The heart is double, each half having an auricle and ventricle.

Component parts.— The heart is a double organ, and is made up of two similar halves, right and left. In each half are two hollow portions, an auricle and a ventricle; these communicate, and are provided with vessels for the entrance and exit of the blood. The right half receives black blood by the systemic veins, and sends the same to the lungs by means of the pulmonary artery; but the left half is supplied with red blood from the lungs by the pulmonary veins, and distributes this over the body through the aorta.

Grooves marking position of auricles and ventricles; and partition between these: right most in front.

On the surface of the heart are certain grooves, indicatory of this composition. Thus passing circularly round the heart, nearer the base than the apex, is a groove which cuts off, as it were, the thin auricular, from the fleshy ventricular part. The auricular portion is placed at the base of the organ, and is subdivided into two halves (right and left) by a median partition. In like manner the ventricular portion is parted into right and left ventricles by a septum. The situation of the median partition between the ventricles is recognised by a longitudinal sulcus on the surface: this sulcus does not occupy the mid space either on the anterior or the posterior aspect, but is nearer the left border of the heart, in front, and the right border behind; so that most of the anterior surface is formed by the right, and the greater part of the posterior surface by the left ventricle.

Number and situation of the auricles.

The *auricles* are two (right and left), as before said, and are placed so deeply at the base of the heart, behind the aorta and the pulmonary artery, that only the tip of the right one comes forwards to the sternum. They receive their appellation from the resemblance that the tips or appendices, that project forwards on the sides of the arteries, bear to the dog's ears. The auricles are much thinner than the ventricles, and are recipients of blood from large veins. Of the two, the right is rather the larger and the more anterior; it is joined by the upper and the lower cava, and by veins from the substance of the heart. The left auricle receives the two pulmonary veins of each side.

Veins join their cavities. Right. Left.

The ventricles

The *ventricles* constitute the fleshy part of the heart, and

respondence of the different portions of the heart to points of the wall of the thorax, he may refer to the Papers by Dr. Sibson, in vol. xii. of the *Trans. of the Provincial Med. and Surg. Association.*

are thicker than the auricles, below which they lie. Two in number, like the auricles, each has an opening into the auricle of its own side, by which it receives blood, and another opening into an artery, by which the blood is transmitted from the cavity. Their unequal extent on the aspects of the heart has been before alluded to: thus the right ventricle forms the right thin border and the greater part of the anterior surface, and is prolonged upwards on the left side into the pulmonary artery. The left ventricle enters alone into the apex, the left border, and most of the posterior surface of the heart: with its cavity the aorta is connected.

communicate with arteries.

Number.

The right.

The left.

Dissection.—Before opening the heart, the vessels for the nutrition of its substance (coronary arteries) are to be dissected on the surface, together with the small nerves and veins that accompany them. The two arteries appear on the sides of the pulmonary artery, and occupy the grooves on the surface of the heart, where they are surrounded by fat; one branches over the right, and the other over the left side. With the anterior artery is a plexus of nerves, which is to be followed upwards to the superficial cardiac plexus; and with the remaining artery is another plexus.

Dissect coronary vessels and nerves,

At the back of the heart, in the groove between the auricles and ventricles, the student will find the large coronary vein, and the dilated coronary sinus in which it ends: the last should be defined and followed to its ending in the right auricle.

and coronary sinus.

The *coronary arteries* are two small vessels that are so named from their course around the heart; they are the first branches of the aorta, and arise close above the semilunar valves. One is distributed on the right, and the other on the left side of the heart.

Two arteries of the heart, viz.

a. The *right coronary* branch appears on the right side of the pulmonary artery, and is directed onwards in the depression between the right auricle and ventricle to the posterior aspect of the heart, where it anastomoses with a similar circular offset from the left coronary artery. In this course branches are distributed upwards and downwards to the right half of the heart. Two of these are of larger size than the rest:—one runs on the anterior aspect of the right ventricle towards the free margin; the other descends on the back of the heart, along the septum between the ventricles,

right coronary,

and anastomoses towards the apex with the left coronary artery.

left coronary artery. *b.* The *left coronary* branch is inclined behind the pulmonary artery to the left side of that vessel, then in the groove between the left auricle and ventricle to the back of the heart, where it anastomoses with the right coronary branch. Like the preceding artery, it furnishes offsets to the substance of the auricle and ventricle. The largest of these descends in the anterior sulcus, over the partition of the ventricles, towards the apex of the heart, and communicates with the descending branch of the right coronary artery at the back of the heart.

Veins of the heart. The *veins* of the substance of the heart (cardiac) are not the same in number, nor have they the same distribution as the arteries. There may be said to be three sets, but for the most part they are united into one large trunk, the coronary sinus, which opens into the right auricle.

Coronary sinus; The *coronary sinus* will be seen on raising the heart to be apparently the dilated ending of the great coronary vein. The points in its anatomy will be better seen if it is opened with a scissors. extent; About an inch usually in extent, it is limited on the one side by two valves that exist at the opening of the great coronary vein into it, and on the other by another valve (Thebesian), where it opens into the right auricle. structure; It is crossed by the muscular fibres of the left auricle. Inferiorly and on the right it receives some branches from the back of the ventricles, whose openings are guarded by valves; and nearly at its outer termination is another veins joining. vein without a valve,—the *oblique* vein of Mr. Marshall, that ascends along the back of the left auricle.

Large cardiac vein is single, *a.* The *great cardiac* or *coronary vein* begins in front, near the apex of the heart, in the substance of the ventricles. From this origin, the vessel turns to the back of the heart in and opens into sinus. the sulcus between the left auricle and ventricle, and opens into the coronary sinus. It receives collateral branches in its course, and its ending in the sinus is marked by two valves.

Small anterior and posterior cardiac veins. *b. Anterior* and *posterior cardiac veins.*—Some small veins on the anterior part of the right ventricle open separately, by one or more trunks, into the lower part of the right auricle. Similar small veins exist over the back of

the ventricles; and one, larger than the rest, lies over the septum ventriculorum: they enter the coronary sinus by separate valved openings.

c. Smallest cardiac.—A third set of veins (veins of Thebesius, venæ minimæ) lie in the substance of the heart: these are noticed in the description of the right auricle. Smallest cardiac.

Cardiac nerves.—The nerves for the supply of the heart are derived from a large plexus (cardiac) around the roots of the aorta and the pulmonary artery. Part of this plexus is superficial to the pulmonary artery, and part beneath it; and from each an offset is sent with a coronary artery. Only the superficial part can be now seen. Cardiac nerves.

The small *superficial cardiac plexus* is placed by the side of the ductus arteriosus, and below the arch of the aorta. The nerves that join it are the left superficial cardiac nerve of the sympathetic, the small (cervical) cardiac branch of the left vagus (p. 117.), and a considerable bundle of nerves that comes forwards to it from the deep cardiac plexus. A small ganglionic mass is sometimes seen in the plexus. Inferiorly the plexus ends in nerves to the heart, that accompany the right coronary artery. A few filaments pass on the left division of the pulmonary artery to the front of the root of the lung of the same side. Superficial plexus ends in anterior coronary.

a. The *anterior* or *right coronary plexus* passes downwards from the plexus above described, to reach the right coronary artery, and receives near the heart a communicating offset from the right half of the deep cardiac plexus. Anterior plexus of heart.

b. The *posterior* or *left plexus* is derived, as will be subsequently seen, from the deep cardiac plexus, and accompanies the left coronary artery to the heart. Posterior plexus.

On the heart the nerves at first surround the arteries, but they soon leave the vessels, and becoming smaller by subdivision, are lost in the muscular substance of the ventricles. On and in the substance of the heart the nerves are marked by small ganglia. Accompany the arteries.

The CAVITIES OF THE HEART may be examined in the order in which the current of the blood passes through them, viz., first right auricle and ventricle, and afterwards left auricle and ventricle. Four cavities of the heart.

Dissection.—In the examination of its cavities the heart is not to be removed from the body. To open the right auricle, an incision may be made in it, near the free border, and from the superior cava nearly to the inferior cava; from the centre of that incision the knife is to be carried across Dissection to open right auricle.

the anterior wall to the auricula. By means of these cuts an opening will be made of sufficient size; and on raising the flaps with hooks or pieces of thread, and removing the coagulated blood, the shape of the cavity will be apparent.

Form of right auricle.

The CAVITY OF THE RIGHT AURICLE * is rather of an irregular form, though when seen from the right side, with the flaps held up as above directed, it has somewhat the appearance of a cone, with the base to the right and the apex to the left.

Its base;

The *base* or wider part of the cavity is turned towards the right side, and at its extremities are the openings of the superior and inferior cavæ. Between those vessels the wall of the cavity projects somewhat, and presents a slight elevation in some bodies (tubercle of Lower). The *apex* is prolonged downwards towards the junction of the auricle with the ventricle, and in it is the large opening into the right ventricular cavity.

apex.

Anterior wall presents auricula.

The *anterior wall* is thin and loose. Near its upper part is an opening leading into the pouch of the appendix or auricula, which will admit the tip of the little finger. Around, and in the interior of the appendix, are fleshy bands, named musculi pectinati, which cross in different directions, forming a network that contrasts with the general smoothness of the auricle.

Posterior wall is marked by fossa ovalis.

The *posterior wall* corresponds for the most part, in consequence of the position of the heart, to the septum between the auricles. On it, nearer the inferior than the superior cava, is a large oval depression, the fossa ovalis, which is the remains of an opening in the fetus between the auricles. Inferiorly the fossa merges into the opening of the lower cava. A thin semitransparent structure forms the bottom of the fossa, and there is oftentimes a small oblique aperture at its upper part. Around the upper three fourths of that hollow is an elevated band of muscular fibre, called annulus seu isthmus Vieussenii, which is most prominent above and on the inner side, and gradually subsides inferiorly. Altogether at the lower part of the posterior wall, between the opening into the ventricle and that of the inferior cava, is

Annulus of Vieussens.

Apertures of cardiac veins.

* Sometimes the term cavity of the auricle is applied only to the appendix, and the term sinus venosus to the rest of the space here named auricle.

the small aperture of the coronary sinus. Other small apertures are seen scattered over the surface: some lead only into depressions, but others are the mouths of the veins of the substance of the heart (venæ cordis minimæ), and are named foramina Thebesii.

Apertures of cavæ.

The chief *apertures* in the auricle are those of the two cavæ, of the coronary vein, and of the ventricle; but the openings of the cavæ should be specially noted, because they are so placed that the current of blood issuing from one, in the fetus, does not mix much with that from the other. The opening of the superior cava is in the front and top of the auricle, and its direction is downwards and somewhat forwards. The inferior cava enters the lowest part of the auricle near the septum, and is directed inwards and backwards to the fossa ovalis.

Valves of chief apertures. Inferior cava is provided with Eustachian valve.

All those openings, except that of the superior cava, have some kind of *valve*. In front of the inferior cava is a thin fold of the lining membrane of the cavity, the Eustachian valve, but in the adult this is only a remnant of a structure, that is much larger in the fetus. This valve, in its perfect state, is semilunar in form, with its convex margin attached to the wall of the vein, and the other free in the cavity of the auricle. Its surfaces are directed forwards and backwards. In width, the valve surpasses the size of the vein, so that its extremities reach the surface of the auricle; and the left end is connected with the annulus, or the rim of the fossa ovalis.

One to coronary sinus.

The free margin of the valve is often reticular. The aperture of the coronary sinus in the lower part of the auricle is closed by a thin fold of the lining membrane — valve of Thebesius.

Auriculo-ventricular opening.

The auriculo-ventricular opening will be seen, in examining the right ventricle, to be provided with valves, which prevent regurgitation into the auricular cavity.

Course of blood in auricle in adult, and in the fetus.

In the adult there is but one current of blood in the right auricle towards the ventricle. In the fetus there are two; one of pure, and the other of impure blood, which cross one another. The placental or pure blood entering by the inferior cava, is directed by the Eustachian valve chiefly into the left auricle, through an opening (foramen ovale) in the septum; whilst the current of systemic or impure blood, coming in by the superior cava, flows downwards in front of the other to the right ventricle.

To open right ventricle.

Dissection. — Seizing the right ventricle, the student should pass the scalpel through it below the opening from the auricle, and cutting downwards bring it out inferiorly near the apex of the heart, without injuring the septum ventriculorum. A flap is thus formed, like the letter V, of the anterior part of the ventricle. In the examination of the cavity of the right ventricle, both the flap and the apex of the heart should be raised with hooks, so that the space may be looked into from below.

Cavity of right ventricle.

The CAVITY OF THE RIGHT VENTRICLE is triangular in form, and has the base turned upwards to the auricle of the same side. On a cross section the cavity would appear semilunar in form, and the septum between the ventricles, convex towards the cavity.

Apex. Base and its openings.

The *apex* of the cavity reaches the right border of the heart, at a little distance from the apex. At its *base* the ventricle is sloped, and is perforated by two apertures; one of these, on the right, leading into the auricle, is the right auriculo-ventricular opening; the other on the left, and much higher, is the mouth of the pulmonary artery. The part of the cavity which communicates with the pulmonary artery is funnel-shaped, and is named infundibulum, or conus arteriosus.

Anterior and posterior wall.

The *anterior wall*, or the loose part of the ventricle, is comparatively thin, and forms most of the anterior surface of the ventricular portion of the heart. The *posterior wall* corresponds in greatest part to the septum between the ventricles, and is of considerable thickness.

Interior of the cavity is uneven.

Over the greater part of the cavity the *surface* is irregular, and is marked by projecting fleshy bands of muscular fibres, the columnæ carneæ, but near the aperture of the pulmonary artery the wall becomes smooth. The fleshy columns are of various sizes, and of three different kinds.

On it there are three sets of fleshy columns.

Some merely form a prominence in the ventricle, like those on the septum. Others are attached at each end, but free in the middle (trabeculæ carneæ). And a third set, which are fewer in number, and much the largest, project into the cavity, and form rounded bundles, named musculi papillares; these give attachment by their free ends to the little tendinous cords of the valve of the auriculo-ventricular opening.

The *auriculo-ventricular orifice* is situate in the base of the ventricle, near the right or the free border of the heart, and is opposite the centre of the sternum, between the third costal cartilages: it is slightly larger than the corresponding aperture of the left side of the heart. It is oval from side to side, and its shape is maintained by a strong fibrous band that surrounds it. Prolonged from the circumference of the opening is a thin membranous valve, which projects into the cavity of the ventricle. Near its attachment to the heart the valve is undivided, but it is serrated, or divided into three chief points at its free margin, and is named tricuspid; to this margin are attached small tendinous cords (chordæ tendineæ), that unite it to the muscular bundles of the ventricle.

Opening from the auricle; position; form; is guarded by the tricuspid valve.

The *tricuspid valve* is constructed by the lining membrane of the heart, which encloses fibrous tissues derived from the circumference of the auriculo-ventricular opening. Its three slips or tongues are thus placed: — One is next the front of the ventricle; another is in contact with the posterior wall; and the remaining one, the largest and most moveable, is interposed between the apertures into the auricle and the pulmonary artery. The central part of each segment is strong, whilst the points are thin and notched; and between the primary divisions there are sometimes secondary points (Kürschner). The tendinous cords that keep the valve in position ascend from the musculi papillares in the intervals between the pieces of the valve, and are connected with the two segments between which they lie*: they end on the surface of the valve turned away from the opening, in three different ways; some reaching the attached upper margin of the valve, others entering the central thickened part of the segment, and the rest, that are much finer, ending in the thin point of the tongue of the valve. During the contraction of the ventricle the valve is raised by the blood, so as to close the opening into the auricle, but the farther pro-

Tricuspid valve; how formed; divisions; attachment of tendinous cords, its use.

* The papillary muscles are collected into two principal groups, whose tendons enter the interval on each side of the right or anterior tongue of the valve. In the interval between the left and the posterior segment of the valve the tendinous cords are very small, and are connected with the septum.

trusion of it into the latter cavity is arrested by the small tendinous cords.

Mouth of pulmonary artery; position; The *mouth* of the *pulmonary artery* will be seen when the incision in the anterior wall of the ventricle is prolonged upwards into it. It is situate on the left of the opening into the auricle, and is opposite the upper border of the third costal cartilage of the left side, close to the sternum. Into it the funnel-shaped part of the right ventricle, or the infundibulum is prolonged, and in its interior are three *semilunar* or has three semilunar valves; *sigmoid valves.* Each valve is attached to the side of the vessel by its convex border, and is free in the cavity by the their attachment. opposite border, in which there is a slightly thickened and projecting part that has been named the corpus Arantii.

Structure of sigmoid valves. The *semilunar valves* resemble in structure the tricuspid, for they are formed of fibrous tissue, with a covering of the lining membrane. In the valves the fibrous tissue has a Arrangement of fibrous tissue. special arrangement:—There is one band along the attached margin; a second along the free margin, which is connected with the projecting nodule; and a third set of fibres is directed from the nodule across the valve, so as to leave a triangular or semilunar interval almost free from fibres between it and the band in the free edge, which has been Their use. named lunula. The use of these little valves is obvious, viz. to give free passage to fluid in one direction, and to prevent its return by closing the area of the vessel. Whilst the blood is entering the artery, the valves are placed against the wall; but when the vessel acts on the contained blood, the valves are thrown towards the centre of the cavity, and arrest the return of the circulating fluid into the ventricle.

To open left auricle. *Dissection.*—To open the cavity of the left auricle, the apex of the heart is to be raised, and a cut is to be made across the posterior surface of the auricle from the right to the left pulmonary veins. Another incision should be made in the auricula, at right angles to the former one. The apex of the heart must necessarily be kept raised during the examination of this auricle.

Shape of cavity of left auricle. The CAVITY OF THE LEFT AURICLE is smaller than that of the right side.* Irregularly conical in shape, the wider part is turned towards the spinal column, and receives the

* The division of the cavity into auricle and sinus venosus may be made on this as on the other side.

pulmonary veins; and the narrowed part opens inferiorly into the left ventricle.

On the left side, and at the upper part, is the aperture of the pouch of the auricula, which is narrower than that on the right side. In the interior of the pouch, as well as around the entrance, are the fleshy fibres or the musculi pectinati, which resemble those before seen in the other auricle. On anterior wall is auricula

On the part of the wall corresponding to the septum auricularum, is a superficial fossa of a semilunar form, the remains of the oval aperture through that partition; this is bounded below by a projecting ridge, concave upwards, which is the edge of the structure that closed the opening in the fetus. This impression in the left auricle is above the fossa ovalis in the right cavity, because the aperture of communication between the two, in the fetus, was an oblique canal through the septum. On septum, remnant of foramen ovale.

The *apertures* in this auricle are those of the four pulmonary veins, two on each side, together with the opening of communication with the left ventricle. The mouths of the two pulmonary veins are close to one another; those from the right lung open into the extreme right of the auricle near the septum, and those from the left lung enter the opposite part of the cavity, near the auricula. These veins are not provided with valves. The aperture into the ventricle will be afterwards seen to have a large and complicated valve, as on the right side, to guard it. Openings are four pulmonary veins. One into ventricle.

In the adult, the blood enters this cavity from the lungs by the pulmonary veins, and passes to the left ventricle by the large inferior opening between the two. In the fetus, however, the lungs are impervious to the air and the circulating fluid; and the left side of the heart receives its pure blood at once from the right auricle through the aperture (foramen ovale) in the septum. Current of blood in adult; in fetus.

Dissection.—The left ventricle may be opened by an incision along both the anterior and the posterior surface, near the septum; these are to be joined at the apex, and are not to be extended so far upwards as to reach the auricle. On raising the triangular flap, the interior of the cavity will be seen. How to open left ventricle.

The CAVITY OF THE LEFT VENTRICLE is longer, and more Form of

left ventricle. conical in shape than that of the opposite ventricle, and on a transverse section of the heart it appears oval or almost circular.

Apex. The *apex* of the cavity reaches into the apex of the heart, for the fibres of the left ventricle alone form this part. The *base* is turned towards the auricle, and is sloped slightly in a direction opposite to that of the right ventricle. In this part are the openings into the aorta and the left auricle.

Base with its openings.

Walls. The *walls* of this ventricle are the thickest, and the anterior boundary is formed by the septum ventriculorum.

Inner surface has fleshy columns, but some very large. Its *surface* is irregular, like that of the right ventricle, in consequence of the projections of the fleshy columns, or the carnæ columnæ; but near the great artery (aorta) that leads from the cavity the surface is smooth. Three sets of fleshy columns are seen in this as in the right ventricle, but the set that projects into the cavity and receives the small tendinous threads of the valve is the most marked. The musculi papillares spring from the front and back of the parietes, and are collected, for the most part, into two large muscular projections.

Left auriculo-ventricular aperture. The *aperture* into the *left auricle* (auriculo-ventricular) is placed on the left of the orifice of the aorta, and close to it, only a thin fibrous band intervening between the two. This opening is rather smaller than the corresponding aperture of the right side, and is longest like it in the transverse direction: its position is beneath the right auriculo-ventricular opening, opposite the centre of the sternum. It is furnished with a membranous valve that projects into the ventricle; but this is stronger and of greater length than the tricuspid, and has also firmer and more tendinous cords. Attached to a fibrous ring around the aperture, the valve is divided below by a notch on each side, into two instead of three pieces; its segments lie one before another, having their edges directed to the sides, and their surfaces towards the front and back of the cavity. From a fancied resemblance of it to a mitre it has been called the mitral valve. The anterior tongue of the valve intervenes between the auricular and aortic openings, and is attached above to the fibrous band in that position; it is larger and looser than the posterior segment.

Form and size. Position. It has a large valve named mitral.

Mitral valve. The *mitral* resembles the tricuspid valve in its structure

and office. Its segments consist of thicker and thinner parts; and in the notches at the sides there are also secondary pieces between the segments. The strong tendinous cords ascend to be attached to the valve in the lateral notches between the tongues, and each of the large papillary muscles acts on both divisions of the valve. The ending of the tendinous cords on the surface of the segments is the same as in the tricuspid valve.

Attachment of cords.

The *opening of the aorta* is somewhat on a higher level than that of the auricle, and is next the septum of the ventricles. By slitting up the side of the vessel without cutting the pulmonary artery, its aperture will be found to be round, and rather smaller than that of the pulmonary artery, beneath, and below and internal to which it lies: with respect to the wall of the thorax, it is opposite the lower border of the third left costal cartilage, behind the contiguous part of the sternum. In its interior are three *semilunar* or *sigmoid valves*, which are larger and stronger than the corresponding parts in the pulmonary artery, but have a like structure, attachment, and function. The projection in the centre of each valve, viz. corpus s. nodulus Arantii, is also better marked. Opposite each valve the coat of the aorta is bulged as on the right side, though in a greater degree, and presents also a little hollow on the inner side named sinus of Valsalva. Above the free margin of two of the small valves are the apertures of the coronary arteries.

Aortic opening; position and form. Is guarded by three sigmoid valves.

Position of the ventricular apertures.—Two openings have been seen in each ventricle, one of the auricle of its own side of the heart, and one of an artery. The apertures of the arteries (aorta and pulmonary) are nearest the septum; and as the two vessels were originally formed from one tube, they are close together, but the pulmonary artery is the more anterior of the two. The aperture of communication with each auricle is next the circumference of the heart, and is posterior in its position to the artery that issues from the fore part of the ventricle. The position of the openings to one another, from before backwards, has been before referred to;—thus the right auriculo-ventricular is before the left; and the opening of the pulmonary artery is before that of the aorta, and rather higher than it.

Relative position of the apertures: from before back.

STRUCTURE.—The heart is composed of strata of muscular

Structure of

the heart: fibrous and muscular. fibres, and of certain fibrous rings which serve as fixed points for their attachment. These structures must be studied on a separate heart; or on that of the ox or sheep, in which the fibres have been hardened and the connective tissue destroyed by boiling, so that the fibres can be separated. The description of the structure of the heart may therefore be omitted till a fit preparation of the fibres can be made.

Fibrous bands The *fibrous structure* forms rings around the auriculo-ventricular and arterial orifices, and sends prolongations into the valves connected with those openings.

form rings around auriculo-ventricular openings, *a.* The *auriculo-ventricular rings* give attachment to the muscular fibres both of the auricles and ventricles, as well as to the framework of fibrous tissue in the tricuspid and mitral valves. These bands are distinct from those encircling the arterial mouths, except at the right part of the left auriculo-ventricular opening, where the auricular and the arterial circles are blended.

and around arterial openings. *b.* An *arterial ring* surrounds each large artery (aorta and pulmonary), fixing those vessels, and giving attachment to the muscular fibres and the semilunar valves. Each is a circular band, with an uninterrupted margin towards the ventricle, and a toothed or wavy margin towards the artery.

To these last the sigmoid valves, This last margin has three notches, which are filled by corresponding projections of the artery, and give attachment, internally, to the sigmoid valves along their semilunar edges.

and middle coat of the artery are fixed. The artery is connected with the band of fibrous tissue in the following manner: — The middle coat presents three projecting convex pieces, that are received into and connected with the notches of the fibrous ring, but most intimately with the points; and the union between the two is strengthened externally by the parts around the vessel, and internally by the endocardium.

Muscular substance of heart: is distinct in auricles and ventricles. The *muscular substance* forms concentric bands of fibres, which are arranged mostly in a circular or spiral direction, and enclose the different cardiac cavities. In the wall of the auricles the fibres are quite distinct from those in the ventricles, though both sets are attached to the fibrous circles around the cardiac orifices, as to a common point of origin or insertion. Some of the fibres enter the bases of the auriculo-ventricular valves. The fibres belong to the class

of involuntary muscles, and yet they are marked with transverse striæ.

a. In the *wall of the auricles* the fibres are mostly transverse, and are best marked at the lower part, though they form here but a thin layer; and some of these fibres dip into the septum between the auricular cavities. Besides this set, there are annular fibres around the appendages of the auricles, and the openings of the different veins. Lastly, a few oblique fibres pass upwards over the auricles, and are attached below, both in front and behind, to the fibrous rings surrounding the auriculo-ventricular orifices.

Disposition in the auricles, where they are transverse, annular, and oblique.

b. In the *wall of the ventricles* the fibres are disposed in layers, which pass spirally downwards from the base towards the smaller part of the heart, where they make a sudden bend, and are reflected upwards with a straighter direction and a deeper position, to form the inner surface of the ventricular cavity. To allow of this turning inwards of the fibres, the deepest layers extend the shortest distance from the base of the ventricle. Each ventricle has, for the most part, its own formative fibres, which assist in constructing the septum between the cavities; but some bands are concerned in the production of the wall of both ventricles on the anterior and posterior aspects of the heart, near the base of the ventricles, where the fibres are nearly circular in direction, and cross the interventricular grooves. When these intercommunicating fibres are divided, the ventricles may be detached from one another.*

In the ventricles they pass from base to apex.

The fibres of the ventricles are mostly separate, but some common to both.

Endocardium.— Lining the interior of the cavities of the heart is a thin membrane, which is continuous on the one hand with the lining of the veins, and on the other with that of the arteries. This membrane is so named in opposition to the external investment or pericardium. Where the membrane passes from an auricle to a ventricle, or from a ventricle to an artery, it forms duplicatures or valves, in which fibrous tissue is enclosed. In the ventricle it also covers the tendinous cords of the valves, and the projecting muscular bundles. The thickness of the membrane is less in the auricles than in the ventricles.

Lining membrane of the heart forms folds in the interior containing fibrous tissue.

* For fuller detail concerning the structure of the heart, the student may refer to the article "Heart" in the *Cyclopædia of Anatomy and Physiology.*

Vessels of the heart.

GREAT VESSELS OF THE HEART.— The arteries that take origin from the heart are the pulmonary artery and the aorta. The large veins entering the heart, besides the coronary, are the superior and the inferior cava, and the pulmonary veins.

The pulmonary artery

The PULMONARY ARTERY is a short thick trunk that conveys the dark or impure blood from the right side of the heart to the lungs. From its commencement in the right ventricle, the vessel is directed upwards on the left of the aorta; and at a distance of an inch and a half or two inches from its origin, divides into two branches of nearly equal size for the lungs. Near the bifurcation of the artery is a small ligamentous cord, the remnant of the arterial duct, which passes from the left branch of the vessel to the arch of the aorta, and is named ligamentum ductûs arteriosi.

is a short trunk, and divides into two for the lungs.

Connections.

The trunk of the pulmonary artery is contained in the pericardium; and beneath it is the beginning of the aorta, together with the left auricle. On each side are the coronary artery and the auricula.

Right branch is longest.

The *right branch* is longer than the left. In its course to the lung it lies beneath the aorta and the vena cava superior, and rests on the bronchus or the division of the air tube: and as it passes outwards, it is above the level of the right auricle of the heart. At the lung the artery divides into three primary branches, one for each lobe, which enter the pulmonic substance.

Left branch.

The *left branch* is rather smaller than the right; it is directed in front of the descending aorta and the left bronchus to the fissure of the root of the lung, where it divides into two branches corresponding to the number of the pulmonic lobes.

Space at the bifurcation.

As the right and left branches of the pulmonary artery pass outwards, they cross the divisions of the air tube, and enclose with these a lozenge-shaped space which contains some bronchial glands.

Condition of the artery in the fetus.

Ductus arteriosus.— In the fetus, the part of the pulmonary artery which is now ligamentous, was the continuation of the trunk of the vessel, and was larger than either branch to the lung. At that period the vessel above referred to receives the name arterial canal or duct (ductus arteriosus, Botalli), and opens into the aorta rather beyond the

origin from the arch of the last great vessel of the head and neck. As the lungs do not give passage to the circulating fluid before birth, the impure blood of the pulmonary artery passes into the aorta below the attachment of the vessels of the head and neck, in order that it may be transmitted to the placenta to be purified; but after birth, when the function of the lungs is established, the current of blood is directed along the branches of the pulmonary artery instead of through the arterial duct: then this last channel becomes gradually smaller, and is quite obliterated before the eighth or the tenth day. Use.

The AORTA is the great systemic vessel that conveys the blood from the heart to the different parts of the body. The vessel first arches backwards to reach the spinal column, on which it afterwards extends through the chest and the abdomen. In the thorax, the vessel is divided into two parts — arch of the aorta, and the descending or thoracic aorta. This great vessel extends through chest and abdomen.

Arch of the aorta. — The aorta has its origin in the left ventricle, close below the junction of the cartilage of the third rib of the left side with the sternum. From that point it ascends, curving backwards over the windpipe and the gullet, to reach the left side of the spinal column. And it loses its designation of "arch" at the lower border of the body of the third dorsal vertebra. The arch has its convexity upwards and to the right, and its concavity to the root of the left lung; and from it the large vessels for the supply of the upper part of the body take their origin. For the purpose of reducing to order the numerous connections of this portion of the aorta, the arch is divided into three parts — ascending, transverse, and descending. Its first part is arched. The extent and divisions of the arch.

The first or ascending part is about two inches in length, or slightly more, and is directed upwards behind, and very close to the sternum: it reaches as high as the upper border of the cartilage of the second rib on the right side, and is contained nearly altogether in the pericardium. At first the pulmonary artery is superficial to the aorta; but as these vessels take different directions, the latter is soon uncovered, and remains so to its termination. Behind it are the right branches of the pulmonary vessels. On the right side is the descending cava, and on the left, the pulmonary artery. Near the heart the vessel bulges opposite each First part: length and connections.

semilunar valve, in the situation of the sinuses of Valsalva; and there is sometimes another dilatation along the right side, which is named the great sinus of the aorta. The two coronary arteries arise close to the swellings first alluded to.

Gives origin to coronary arteries.

Second part is transverse.

The second or transverse piece recedes from the sternum, and reaches from the second right costal cartilage to the left side of the body of the second dorsal vertebra. It rests upon the trachea above its bifurcation, as well as over the œsophagus and the thoracic duct. Lying in front of this part of the artery are the pneumo-gastric, phrenic, and superficial cardiac nerves of the left side; and the first nerve sends backwards its recurrent branch beneath the vessel. Along the upper border is the left innominate vein; and to the lower border, near its termination, the remnant of the arterial duct is attached. From this part arise the three great vessels of the head and the upper limbs.

Connections.

Gives origin to large vessels.

Third part is without vessels.

The third or descending part of the arch is very short, extending only from the second, to the lower part of the third dorsal vertebra. It lies against the third dorsal vertebra, and the fibro-cartilage between this and the second; and it is covered by the pleura of the left side of the chest.

Parts contained in the arch.

In the concavity of the arch of the aorta are contained the left auricle of the heart, the root of the left lung, the branching of the pulmonary artery with its arterial duct, and the left recurrent nerve. Deeper than these bodies, will be found the œsophagus and the thoracic duct, with some lymphatic glands.

Five branches of the arch: two coronary, innominate, carotid, subclavian.

The *branches* of the arch of the aorta are five in number; two come from the ascending, and three from the transverse part. The first two are the coronary arteries of the heart, which have been already noticed (p. 353.). The other three are much larger in size, and supply the neck, the head, and the upper limbs. First on the right is the large trunk of the innominate artery; close to it is the left carotid; and last of all is the left subclavian, which is distant a small space from the preceding vessel.

Peculiarities.

Peculiarities. — The exceptions to the usual condition of the arch of the aorta, that the student may expect to find, concern the height and direction of the arch, and the position and number of its branches.

Height.—The arch reaches commonly to about an inch from the upper part of the sternum, but it may ascend nearly to the top of that bone, or stop an inch and a half or more from it. Height and

Direction.—Sometimes the aorta is arched over the root of the right instead of the left lung, as in birds; and is directed afterwards to its usual place on the spinal column, without any other change in the position of the viscera of the body. Or, all the viscera of the cavities of the thorax and abdomen being transposed, the arch of the aorta may share the general disturbance in position. direction of the arch.

Position of branches.—The large branches of the neck may have their usual origin (the highest part of the arch) moved more to the right; or their distance from one another may be increased or diminished. When there is transposition of the arch there is likewise change in the position of the branches—the innominate artery supplying the left side, and the carotid and subclavian vessels on the right side having separate attachments to the arch. Position of the primary branches.

Number usual, arrangement different.—In transposition of the arch, the left carotid and subclavian are united as before said; or without change in the situation of the arch the carotids may be joined, and the subclavians separate. Number usual, not arrangement.

Number of branches unusual.—The most frequent change in number is the reduction of the branches of the arch to two, as when the left carotid arises from the innominate artery, or when, though rarely, the left carotid and left subclavian are conjoined. But the number may be increased to four by the absence of the innominate trunk, and the separate origin of the right carotid and subclavian arteries from the arch:—in this last case the right subclavian varies in its position, though commonly it is attached to the arch of the aorta, to the left of the rest. Lastly, there may be five or six trunks from the arch; and in instances of this state, the internal and external carotids take their origin from it, in consequence of absence of the trunk common to the two, on one or both sides. Their number may be reduced to two, or increased to four, five, or six.

Occasional branches.—Some smaller or *secondary arteries* take origin occasionally from the arch. The most frequent example of this peculiarity is seen in the origin of the left vertebral artery between the left carotid and subclavian trunks, or beyond them. Occasionally a thyroid artery (lowest thyroid), or the right internal mammary, or both vertebrals, will be seen to spring from the arch of the aorta. Number increased by secondary branches.

The *innominate artery* (brachio-cephalic) is the largest offset of the transverse part of the arch, and is the first of the three branches. It is a thick trunk, varying from one inch and a half to two inches in length; ascending to the right, beneath the sternum, it divides opposite the sterno- Innominate artery ends in carotid and subclavian.

clavicular articulation, into right carotid and subclavian arteries. The artery is crossed by the left innominate vein, and is behind the upper piece of the sternum, and the origin of the hyoid and thyroid muscles. At first the innominate artery rests on the trachea, but as it ascends it is placed on the right of the air tube. On its right is the innominate vein of the same side, with the phrenic nerve. Usually no lateral branch arises from the artery.

Length and connections.

Length may be altered;

Peculiarities. — The *length* of the artery may exceed two inches, or it may be only one inch or less: in these different states the place of bifurcation will be altered, being in the one case beyond, and in the other below the level of the upper border of the clavicle.

branches from it.

Branches. — The left carotid is frequently joined with this artery at its origin. Or a branch to the thyroid body (art. thyroidea ima), or to the thymic body, or to the root of the lung, may arise from the innominate.

Position.

Position. — The innominate artery is directed to the left side of the neck in cases of transposition of the arch. (See p. 369.)

Left common carotid arises from arch of aorta.

Left common carotid artery. — The common carotid artery of the left side of the neck springs from the arch of the aorta, and is therefore longer than the right by the distance between the arch and the top of the sternum.

Connections in the thorax.

In the thorax the artery ascends obliquely to the left sterno-clavicular articulation, but not close to the first piece of the sternum and the origin of the depressor muscles of the hyoid bone and larynx. In that course it crosses beneath the left innominate vein, and the remains of the thymus gland; at first it lies on the trachea, but it afterwards crosses to the left of that tube, so as to be placed over the œsophagus and the thoracic duct. To its outer side is the left pneumo-gastric nerve, with one or more cardiac branches of the sympathetic nerve. In the neck, the connections of the vessels of opposite sides are the same (p. 79.).

Peculiarities in its origin.

Peculiarities in origin. — The most frequent change in this vessel consists in alteration in its origin. The carotid is sometimes united with the innominate artery; or, should the innominate artery be absent, the common carotids, right and left, arise usually by one trunk. Its junction with the left subclavian is rare, except with transposition of the arch.

In position.

In position. — It seldom changes its relative position with respect to the other branches of the arch, but if this is altered it tends generally towards the right.

The *left subclavian artery* arises from the arch of the aorta, and ascends to the lower part of the neck through the upper aperture of the thorax. Beyond the first rib the vessels of opposite sides are alike (p. 71.). Left subclavian artery.

The left subclavian trunk is directed almost vertically from the arch of the aorta to the inner margin of the first rib. In the thorax the vessel lies deeply, resting at first on the side of the œsophagus, and afterwards on the vertebral column and the longus colli muscle; it is invested by the left pleural bag in all its extent. On its inner side are the trachea and the œsophagus, with the thoracic duct. Somewhat anterior to the level of the artery, though running in the same direction, are the vagus nerve and some of the cardiac nerves. Course and connections in the thorax.

Peculiarities in origin. — The left subclavian is subjected less frequently than the other branches of the arch to variations from its ordinary arrangement. Occasionally it arises in common with the left carotid when the arch has its usual direction. Should there be transposition of the arch, the subclavian arises usually from an innominate trunk; but this is not a constant rule, for the subclavian, in such a condition of the vessels, may be the last on the arch, like the right vessel, and cross the front of the spinal column to take its place in the neck: or it may take origin, though rarely, from a dilatation connected with the remains of the arterial duct. Variations in its origin not frequent.

Right artery from the arch. — In some instances the right subclavian arises from the arch of the aorta, and when this peculiarity exists, the vessel may be placed first, second, or third, though most frequently it is last on the arch. To reach the inner margin of the first rib of the right side, when it is last on the arch (most to the left), the artery is directed between the œsophagus and the vertebral column, or it may be, as in one case, between the trachea and the œsophagus. The right subclavian may be also connected with a pouch, — the previous part of the ductus arteriosus, in the same way as the left subclavian. (See the work of Mr. Quain, p. 159.) Right subclavian may arise from the arch.

Veins of the Heart. — These are, as before said, the superior and the inferior cava, and the pulmonary veins: the former are the great systemic veins that return impure blood to the right auricle; and the latter convey pure blood from the lungs into the left auricle. Veins of the heart are

superior cava; which is formed by innominate veins; The *superior* or *descending cava* is formed by the union of the right and left innominate veins, and brings to the heart the blood of the head, neck, upper limbs, and thorax. Its origin is on the right side of the sternum, opposite the interval between the cartilages of the first two ribs. From that spot the large vein descends to the pericardium, perforates the fibrous layer of that bag about one inch and a half above the heart, and ends in the right auricle. ends in heart. On its outer aspect the vein is covered by the pleura of the right side, and the phrenic nerve is in contact with it. To the inner side is the ascending part of the arch of the aorta. Behind the vein is the root of the right lung.

Its branches. When the cava is about to perforate the pericardium it is joined by the large azygos vein of the thorax: higher than that spot it receives small veins from the pericardium, and the parts in the mediastinal space.

Innominate veins are right and left. The *innominate veins* are united inferiorly in the trunk of the descending cava: they are two in number, right and left; and each is formed, behind the inner end of the clavicle, by the union of the subclavian and internal jugular veins of the same side of the neck. How formed. The trunks differ in length and direction, and in their connections with the surrounding parts.

Right an inch and a half long; The *right* vein is about one inch and a half long, and descends vertically, on the right side of the innominate artery, to its junction with the vein of the opposite side. On the outer surface the pleura covers it, and along it the phrenic nerve is placed.

left, twice as long and oblique in direction. The *left* vein is twice as long as the right, and is directed obliquely downwards above the level of the arch of the aorta, to join with its fellow in the superior cava. Between its origin and termination the vein crosses behind the sternum, and the remains of the thymus gland; and it lies on the three large branches of the aortic arch, as well as on the several nerves that descend over the arch.

Their branches. The *branches* of these veins are nearly alike on the two sides. Each receives the internal mammary, the inferior thyroid, and the superior intercostal of its own side; and the left vein is joined in addition by some small thymic and pericardiac veins.

Sometimes *Peculiarities.* — Sometimes the innominate veins are not united

into one, but descend separately to the heart, where both have distinct openings in the right auricle. When such a variety exists, the right vein takes the course of the upper cava; but the left vein descends in front of the root of the left lung, and turning to the back of the heart, receives the cardiac veins, and opens into the right auricle. A cross branch is found connecting the two above the heart.* they open separately into the heart.

This occasional condition in the adult is a regular one in a very early period of the fetus; and two vessels are also persistent in some mammalia. This usual in fetus.

The changes that take place in the veins during the growth of the fetus, so as to produce the arrangement common in the adult, concern mostly the trunk on the left side. The following concise statement may serve as an outline of them. First the cross branch between the two trunks enlarges, and forms the future left innominate vein. And the left trunk below the cross branch then disappears at its middle, and undergoes transformations at each end: — At the upper end it becomes converted into the superior intercostal vein. At the lower end it remains pervious for a short distance as the coronary sinus; and even the small oblique vein opening into the end of that sinus in the adult (p. 354.), is a remnant of the part of the trunk of the vein that lay beneath the heart. Mr. Marshall finds in the adult another vestige of the occluded vessel in the form of a fold of the serous membrane of the pericardium in front of the root of the left lung: this he names the *vestigial fold* of the pericardium. How two are changed into one. Forms coronary sinus. Vestiges in the adult.

The *inferior* or *ascending cava* enters the right auricle as soon as it has pierced the diaphragm. No branches open into the vein in the thorax. The anatomy of this vein will be given with that of the vessels of the abdomen. Inferior cava.

The *pulmonary veins* are two on each side; they issue from the fissure of the root of the lung, and end in the left auricle; their position to the other vessels of the root has been noticed at p. 348. Four pulmonary veins.

The right veins are longer than the left, and lie beneath the aorta and the right auricle of the heart. The superior one receives its roots from the upper and middle pulmonic Right veins longest

* An example of those two large vessels "double vena cava," opening into the heart in the adult, has been given to the College Museum by Dr. Sharpey. The student may consult an excellent paper by Mr. John Marshall, on the development of the veins of the neck.— *Philosoph. Trans. for* 1850.

lobes, and the inferior vein is formed by branches of the lower lobe.

Left. The left veins cross in front of the descending aorta; and one springs from each lobe of the lung.

Their number varies. *Peculiarities in number.* — The number of the pulmonary veins may be altered by the union of those of the left side into one; or by the want of union on the right side, from which three trunks result, corresponding to the three lobes of the lung. But other peculiarities may be found as to number, for six or seven veins, taking both sides together, have been met with; and a bronchial vein has been found opening into one of the left veins.

Join cava. *In the ending.* — The veins of the right side have been observed to open in an adult into the vena cava..

NERVES OF THE THORAX.

Nerves of the thorax. The pneumo-gastric and the sympathetic nerves supply the viscera of the thorax. Some other nerves (intercostal) which are contained in the wall of the thorax, will be afterwards dissected. In the cavity of the thorax is the phrenic nerve, but this only courses through it to the diaphragm.

To trace the nerves, particularly vagus. *Dissection.*— The phrenic nerve is sufficiently denuded for its examination; but the student should trace the vagus nerve through the cavity of the thorax. The vagus is to be followed, on both sides, behind the root of the lung, and its large plexus in that position is to be dissected out: some filaments of the gangliated cord of the sympathetic, that come forwards to the plexus, must be looked for. In front of the root, the nerve supplies a few pulmonary filaments, especially on the left side. From the root of the lung the vagus is to be pursued along the œsophagus, by raising the lung and removing the pleura.

Phrenic nerve is derived from the cervical plexus, The PHRENIC NERVE (internal respiratory) is a muscular branch from the cervical plexus to the diaphragm (p. 78.). In its course through the thorax, it lies along the side of the pericardium, and at a little distance from the root of the lung, with a small companion artery. When near the diaphragm each is divided into branches that perforate the fleshy fibres, and are distributed on the under surface. The nerves of opposite sides differ in length, and in their connections above the root of the lung.

and passes through thorax to the diaphragm.

The *right* nerve is deeper at first in its position, and is also shorter and straighter than the left. As it enters the chest the nerve crosses behind the subclavian vein, but in front of the internal mammary artery; and it lies afterwards along the right side of the innominate vein and the superior cava till it comes in front of the root of the lung. Right nerve above root of lung.

The *left* nerve has the same position to vessels as the right when entering the cavity, but it is directed in front of the arch of the aorta to the root of the lung; and, lower down, it makes a curve around the projecting heart. Before reaching the arch of the aorta, the nerve is external to the left common carotid artery, and crosses the left vagus from without inwards, so as to be internal to that nerve on the arch. Left nerve above root: is longer than right.

Branches. — Some small filaments are said to be furnished from the nerve to the pleura and pericardium; and occasionally the nerve is joined, near the upper part, by a twig from the branch of the nerve to the subclavius muscle. Some offsets.

Internal mammary artery. — A small part of this artery, which furnishes a branch to the diaphragm, has not yet been noticed. This part intervenes between the point of entrance of the artery into the chest (p. 74.), and its course through the cavity along the side of the sternum (p. 266.). Lying beneath the first rib the vessel winds round the phrenic nerve and the innominate vein to reach the side of the sternum. It gives the following offset: — Internal mammary artery winds round aperture of thorax,

The *superior phrenic branch* (comes nervi phrenici) is a very slender artery, that accompanies the phrenic nerve to the diaphragm, and is distributed to that muscle, anastomosing therein with the other arteries from the aorta, and with the musculo-phrenic branch of the internal mammary. and gives phrenic branch.

The PNEUMO-GASTRIC NERVE is one of the three trunks constituting the eighth cranial nerve (p. 116.). Like the phrenic nerve, each passes through the thorax in its course from the neck to the abdomen. In the lower part of the thorax the nerves resemble one another in their course, for they pass behind the root of the lung, each on its own side, and along the œsophagus to the stomach. But above the root of the lung, the right and left nerves differ as much as the phrenic. Each supplies branches to the viscera, viz. to the heart, the lungs, and the gullet. Vagus nerve in the thorax corresponds on both sides below root of lung.

Right vagus above the root of the lung,

The *right* nerve is posterior to the left in its position. As the nerve appears in the thorax, it lies between the subclavian artery and the right innominate vein, and sends backwards a recurrent branch round the former. At first it is directed obliquely backwards, over the side of the trachea, to the interval between that tube and the œsophagus; and thus supported, the nerve reaches the posterior aspect of the root of the lung, where it forms the posterior pulmonary plexus. From the plexus two large offsets are continued to the œsophagus, and unite into one near the diaphragm: the trunk thus formed, lies behind the gullet, and passes along it to the posterior surface of the stomach.

and on the back of the œsophagus below root.

Left nerve above the root of the lung,

The *left* nerve enters the thorax behind the left innominate vein, and to the outer side of the left common carotid artery. Lying between the left subclavian and common carotid arteries, the nerve courses over the arch of the aorta, then beneath the root of the lung, and forms there a larger plexus than on the right side. From the pulmonic plexus one or two branches pass to the front of the œsophagus, and join with the corresponding branches of the right nerve in a plexus on that tube. Finally, the divisions of the nerve are collected into one trunk, which is continued on the front of the œsophagus to the anterior part of the stomach.

and on the front of the œsophagus.

Branches are,

The *branches* of the pneumo-gastric nerve in the thorax are the following: —

recurrent laryngeal in the thorax;

1. The *recurrent* or *inferior laryngeal* nerve is the first branch in the thorax. Arising on the right side on a level with the subclavian artery, and on the left at the lower border of the arch of the aorta, the nerve bends backwards to the trachea, along which it ascends to the larynx. On each side this branch is freely connected with the cervical cardiac branches of the sympathetic nerve, especially on the left side beneath the arch of the aorta.

cardiac branches in the thorax;

2. *Cardiac branches* (thoracic). — Besides the cardiac branches furnished by the vagus in the neck, there are other offsets in front of the trachea to communicate with the cardiac plexus. These branches come from the trunk and the recurrent branch of the nerve on the right side, but they are supplied by the recurrent nerve alone on the left side.

lower cardiac branch of the neck;

The termination of the lower *cervical cardiac branch* of each nerve (p. 117.) may be now seen. The branch of the right vagus lies by the side of the innominate artery, and joins a cardiac nerve of the sympathetic from the neck; but the branch of the left vagus

crosses over the arch of the aorta, and ends in the superficial cardiac plexus.

3. *Pulmonary branches.* — There are two sets of branches for the lung, one to the anterior and the other to the posterior aspect of the root. Pulmonary branches.

a. The anterior branches are two or three in number, and of small size, and communicate with filaments of the sympathetic on the pulmonary artery. These nerves are best seen on the left side. Small anterior.

b. The posterior branches are the largest and much the most numerous, and are obtained by the splitting of the trunk of the nerve after it has become flattened. Forming a plexiform arrangement (posterior pulmonary plexus) behind the root of the lung, these nerves are joined by filaments from the third and fourth ganglia of the knotted cord of the sympathetic, and are conveyed into the interior of the lung on the divisions of the air tube. Large posterior form a plexus.

4. *Œsophageal branches* are furnished to the gullet all along the thorax, but in greatest abundance in the lower half. Below the root of the lung the branches of the pneumo-gastric nerves surround the œsophagus with a network, which has been named *plexus gulæ*. Œsophageal branches form a plexus.

Sympathetic Nerve. — In the thorax the sympathetic nerve consists, as in the abdomen, of a knotted cord along each side of the spinal column, which communicates with the spinal nerves: and of a large prevertebral or cardiac plexus, which distributes branches to the viscera, viz. to the heart and the lungs. Part of the sympathetic in thorax consists of

The gangliated cord will be seen in a future stage of the dissection, after the heart and the lungs have been removed. a gangliated cord,

The *cardiac plexus* lies at the base of the heart, around the great bloodvessels. A part of this network, the superficial cardiac plexus, has been already described (p. 355.). The remaining part, or the deep cardiac plexus, will be found beneath the arch of the aorta by means of the dissection given below. and a central cardiac plexus.

Directions. — The cardiac plexus has been interfered with by the previous examination of the heart, but, by following the directions now given, the student will obtain a knowledge of the disposition of the nerves, and will be able to make a complete dissection of them when the opportunity offers. Dissection of the plexus.

Dissection. — The arch of the aorta is to be cut across To find

the right part. with care, close above the pulmonary artery, and to be drawn well over to the left side: next, the descending cava is to be divided above the entrance of the vena azygos, and its lower part thrown down. By the removal of some fibrous and fatty tissues and lymphatic glands, the right part of the plexus, in which the cervical cardiac branches of the sympathetic and pneumo-gastric nerves of the right side are united, will be seen in front of the trachea, above the right branch of the pulmonary artery. The offsets to the heart should be followed downwards on the trunk of the pulmonary artery; and those to the right lung should be traced along the branch of that artery.

To expose the left part. To lay bare the part of the plexus into which the cervical branches of the sympathetic and vagus nerves of the left side of the body enter, the arch may be cut through a second time, to the left of the junction of the ligamentum arteriosum with it; and that ligament is to be divided, so as to allow the transverse part of the arch to be turned upwards with the great vessels attached to it. The lymphatic glands and the connective tissue are to be cleared away from the nerves, as on the opposite side; and the nerves are to be followed downwards to the heart, chiefly to the posterior coronary plexus.

Nerves entering the deep cardiac plexus. In the *deep cardiac plexus* are united the several cardiac nerves derived from the ganglia of the sympathetic of both sides of the neck, except the highest nerve of the left side: and in it are collected also all the cardiac branches of the vagus nerves in both the neck and chest, with the exception of the lowest cervical cardiac branch of the left side. This large centre is situate between the trachea and the arch of the aorta, above the branches of the pulmonary artery; and from it nerves are furnished to the heart and the lungs. The several nerves entering the plexus are not intermingled in a ganglionic mass in front of the trachea; but those of the right side unite together on the corresponding part of the air tube, and those of the left half of the neck have a like disposition on their side.

Its situation; is formed of two parts, right and left.

Right part how formed. *a.* The *right* part of the plexus is above the right branch of the pulmonary artery, and receives the nerves of the right side, viz. the cardiac nerves of the sympathetic in the neck; the cardiac branches of the trunk of the vagus, both in the neck and chest,

and the cardiac offsets of its recurrent branch. The offsets of this half of the plexus are distributed mostly to the right side of the heart. From its lower end cardiac nerves pass downwards before and behind the right branch of the pulmonary artery. Those in front of that vessel run on the trunk of the pulmonary artery nearly to the heart, where they send a few twigs behind the vessel, to join the plexus on the posterior coronary artery; and lastly, they appear between the aorta and the pulmonary artery, and end in the anterior coronary plexus (p. 355.). The other nerves, those that are behind the branch of the pulmonary artery, supply the right auricle of the heart. Offsets are also sent laterally on the branch of that artery to the nerves of the root of the lung.

Branches are distributed to the heart

in the anterior coronary plexus.

A few go to root of lung.

b. The *left* half of the plexus is close to the ligamentum arteriosum, and rather on the left of the trachea. In it are collected the cardiac nerves of the sympathetic cord of the left side of the neck, except the highest, and in addition it has numerous and large branches of the left recurrent nerve of the vagus. Nerves descend from it around the left branch of the pulmonary artery to the trunk of that vessel, on which they are continued to the heart; and after supplying nerves to the left auricle, they terminate in the bundle of nerves of the posterior coronary plexus (p. 355.). A considerable offset is directed forwards to the superficial cardiac plexus by the side of the ligamentum arteriosum; and some nerves reach the left anterior pulmonary plexus by passing along the branch of the pulmonary artery to the lung.

Left part; nerves entering it.

Offsets descend to left coronary plexus

and to root of lung.

The *cardiac branches* of the gangliated cord of *the sympathetic nerve* in the neck (p. 122.), are now seen at their termination in the thorax. The nerves enter the chest on each side, over or beneath the subclavian artery, and join in the deep cardiac plexus, with one exception in the left superficial cardiac branch.

Other cardiac nerves from the neck.

On the right side. — Though usually three in number, there may be but two cardiac nerves on this side, for the highest nerve is sometimes blended with one of the other two. The middle and inferior nerves pass beneath the subclavian artery to the right half of the deep cardiac plexus. All three communicate with the branches of the recurrent laryngeal nerve of the vagus at the root of the neck, or in the upper part of the thorax, as well as with one another.

All on the right side enter deep plexus.

On the left side the superficial or highest cardiac nerve passes for the most part over the arch of the aorta, and ends in the superficial cardiac plexus, but it may give a branch beneath the arch to the deep plexus. Only one other large

On left one enters superficial, others deep plexus.

nerve may be seen entering the left side of the deep cardiac plexus, for oftentimes the middle cardiac throws itself into the lower cardiac nerve.

THE TRACHEA AND THE LUNG.

To see the trachea and its divisions,

Dissection.— To see the bronchi, or the divisions of the air tube in the root of the lung, it will be necessary to remove the pulmonary artery and its branches, together with the pulmonary veins. When the transverse part of the arch of the aorta, which has been already cut through, is turned to one side, the dissector will be able to clear away the bronchial glands, the nerves, and the fibrous tissue from the part of the trachea in the thorax, and from the branches into which it bifurcates.

Trachea lies in the neck, and in the thorax, where it ends in bronchi.

The TRACHEA, or the air tube, reaches from the larynx to the lungs, and lies on the front of the spinal column. The tube begins at the lower part of the larynx, opposite the fifth cervical vertebra; and ends at the third dorsal vertebra *, by dividing into two pieces (bronchi), one for each lung. Its connections in the neck are described at p. 127., and its structure at p. 176. The part in the thorax remains to be studied.

Its connections in the thorax.

In the thorax the trachea is situate, with the great vessels, in the space between the pleural bags. Here it is covered by the arch of the aorta, by the innominate and left carotid arteries, and by the cardiac plexus of nerves; and superficial to the last arteries is the left innominate vein. Behind the air tube is the œsophagus, which is slightly inclined to the left near the arch of the aorta. On the right side are the vagus, and the innominate artery for a short distance after this has passed over the trachea; and on the left side is the vagus with its recurrent branch.

Bronchi lie in the roots of the lungs; are like the trachea in form.

The *bronchi*, or the divisions of the air tube, are contained in the root of the lung, where they are surrounded by vessels, glands, and nerves. Near the lung each is divided into as many primary pieces as there are lobes to that organ. In their structure and form the bronchi resemble the windpipe, for they are round and cartilaginous in front,

* The place of its bifurcation is sometimes opposite the fifth dorsal vertebra.

but flat, and muscular and membranous behind. Their position behind the other pulmonary vessels has been described at page 348., but the characters of each are now to be noticed.

The *right* branch is about an inch in length, and is larger than the left; it passes outwards on a level with the fourth dorsal vertebra, and is placed above the right pulmonary artery: the vena azygos arches over it. The *left* branch is about two inches long. It is directed obliquely downwards through the arch of the aorta, and joins the root of the left lung, at a spot a vertebra lower than on the opposite side. In this course the tube lies on the œsophagus and the thoracic duct, and on the descending aorta; it is at first below the level of the corresponding pulmonary artery.

The right differs from the left branch in length,

course, and connections.

Dissection. — The lungs are next to be removed from the body in order that their physical characters and the structure may be learnt: they will be separate as soon as the vessels of the root are cut through. Next, the remains of the heart and pericardium are to be taken away. To effect their removal the inferior cava is to be divided, and the pericardium to be detached from the surface of the diaphragm; and in doing this, some care should be taken by the dissector not to injure the parts contained in the interpleural space in front of the spine.

Remove the lungs to examine them.

Physical Characters of the Lung. — The surface of the lung is smooth and shining, in consequence of its pleural investment. Through the serous covering the mass of the lung may be seen to be divided by septa, and by dark spots or sometimes lines, into small irregularly-sized pieces or lobules. On looking closely at the pulmonary substance, especially at a thin margin, the texture will be perceived to be spongy, or composed of minute cells.

Surface is smooth; is marked by lobules and small cells.

The tint of the lung varies with age. In infancy the colour is a pale red; but in the adult the texture becomes grayish in colour, and presents here and there dark gray spots or lines, whose colour deepens with increasing age, and becomes even black in old people. From the position of the body after death, the colour of the posterior border may be of a bluish black shade.

Colour varies with age.

Accidental colour.

To the touch the lung is soft and yielding, and on a sec-

Consistence.

tion being made into it, the pulmonary substance will appear porous and spongy; but the lung which is deprived of its air by pressure has a tough leathery feel. In the ordinary condition of the lung, slight pressure with the thumb and finger drives the air from its containing cells through the pulmonary structure, and produces the noise known as crepitation. If the lung contains serum, a frothy red fluid will run out when it is cut. The texture of the lung is very elastic; this elasticity causing the organ both to diminish greatly when the thorax is opened, and to expel air that may be blown into it.

Crepitation, and elasticity of the pulmonary texture.

Specific gravity, and weight of the lung.

The specific gravity of the lung varies with the conditions of dilatation and collapse, or of infiltration with fluid. When the pulmonary tissue is free from fluid, and filled with air it floats in water; but when it is quite deprived of air it is slightly heavier than water, and sinks in that fluid. The weight of the lung is influenced greatly by the quantity of fluid or other material contained in its texture; ordinarily it varies from eighteen to twenty-one ounces, and the right lung is about two ounces heavier than the left. In the male the lungs are larger, and slightly heavier than in the female.

Follow bronchi and vessels into the lung.

Dissection.—By tracing the large branches of the bronchi, and the bloodvessels and nerves into the lung, the mode of branching of the air tubes will be apparent; and by inflating a part of the lung, the cellular structure may be seen. But the arrangement of the air cells about their tube, and that of the different vessels cannot be ascertained without injections and a microscope.

Outline of the elements of the lung.

STRUCTURE OF THE LUNG.—The spongy pulmonary structure consists of minute cells, in which the smallest branches of the air tube terminate; and the mass of the lung is formed by the collection of those cells into small groups or lobules, and by the aggregation of these into larger masses or lobes. Each lobule is distinct from the surrounding ones, and is furnished with its air tube and nerves, and with its own set of vessels concerned in both its function and nutrition. The constituents of the lung are united by a serous covering, which is prolonged continuously over the surface, and by a subserous layer of connective tissue which penetrates into the interior, subdividing

it into pieces. These several parts are examined more in detail below.

Serous and subserous coverings. — The coat derived from the pleura is thin and transparent, and forms an entire capsule for the lung, except at the root, where the vessels enter. The subserous layer contains fibres of elastic tissue, and not only covers the surface, but extends inwards, establishing the division of the mass into lobules: where it separates the lobules it is named interlobular connective tissue, and is there free from fat. Serous and subserous coverings.

Bronchial branches in the lung. — When a bronchus is followed into the pulmonary structure, it is found to divide generally in a binary order, and to diminish in size at each subdivision, until one terminal offset appertains to a lobule. In the lobule, the tube has a diameter of $\frac{1}{50}$ to $\frac{1}{30}$ of an inch. When this last degree of diminution is arrived at, the tubes give origin to the air cells. Divisions of the bronchi in the lung, till they end in cells.

The larger bronchial branches have the same constituent parts as the trachea, only these are somewhat differently arranged; and they are round in the lung, instead of being hemispherical as in the trachea. The smallest branches, and the air cells, want some of the common structures; and those from which the cells spring are irregular in shape, appearing to be spaces amongst the cells rather than tubes with continuous walls. Difference in large and small tubes in structure and in form.

Changes in the elements of the bronchi. — The modifications which the elementary pieces of the air tube undergo in the bronchial divisions and in the air cells are the following: — The *pieces of cartilage*, which are regularly arranged in a line in the trachea, become broken up in the bronchial tubes, and scattered over the wall as irregular fragments. Becoming thinner and smaller as the subdivision of the air tube proceeds, they at last disappear, and are absent from the terminal branches. The *fibrous* and *elastic* tissues of the bronchial tubes are continued even to the air cells; but in the small cell-bearing branches, the bundles of elastic tissue are diffused, and the two textures, much diminished in strength, are blended together to form the parietal structure. The *muscular fibres*, that exist only at the back of the trachea, are diffused over the inner surface of the bronchi, where they have an annular arrangement, and extend Constituents of the air tube in the lung. Pieces of cartilage. Fibrous and elastic tissue. Muscular fibres.

along the air tube beyond the limit of the pieces of cartilage, but they cease where the cells begin to be formed. The *mucous membrane* becomes thinner as it extends onwards along the air tube, and is finally continued to the cells, where it is transparent. Its ciliated columnar epithelium is changed for nucleated scaly or pavemental in the air cells.

Mucous membrane.

Lobules, how formed.

Lobules and lobes.— A lobule is a cluster of air cells around a terminal branch of the air tube. Varying in size and shape, the lobule is invested by connective tissue, and possesses its own offset of the air tube, as well as distinct branches of vessels and nerves. The larger masses of the lung, viz. lobes, are produced by the aggregation of the lobules.

Lobes.

Nature and form of the air cells;

The *air cells* are the little sacs or dilatations in which the smallest branches of the air tube terminate. They are polyhedral in form, except on the surface, and are distinct one from another, save through the channel of the air passage. The cells are clustered in groups around the terminal division of the air tube, and are situate both along the sides and at the extremity of the passage, with which they communicate by large orifices. In size, these small cells vary from $\frac{1}{200}$ to $\frac{1}{70}$th of an inch across, but they are larger on the surface and at the edges than in the deeper parts of the lung. The cell wall is formed by fibrous tissue, with some scattered fibres of elastic tissue, and is lined by a transparent mucous membrane possessing scaly epithelium.* Beneath the mucous lining is a network of the pulmonary vessels.

position on air tubes.

Size.

Structure.

Vessels of the lung are functional and nutrient, viz.

Vessels of the lung.— Two sets of vessels are furnished to the lung, one being concerned in its function, the other in its nutrition. The vessels that convey blood to the lung to be aërated, or that carry the same away after it has been subjected to the respiratory process, are named pulmonary; whilst the vessels connected with the nutrition of the structure are called bronchial.

pulmonary artery

a. The *pulmonary artery* after entering the lung, divides like the bronchus which it accompanies to the lobule. At the lobule the arterial branch is minutely subdivided, and its ramifications, entering the interlobular fissures, end in a capillary network in the

* Some excellent observers deny the existence of an epithelial mucous lining to the cells.

wall of the air cells, beneath the mucous lining. The vascular circle around one cell communicates with the contiguous ones. The *pulmonary veins* begin in the vascular network before mentioned, and the twigs issuing from the several lobules are united in larger tubes, which course to the root of the lung. Although the small lobular branches of the arteries remain separate from one another, the corresponding veins anastomose together. and vein;

b. The *bronchial arteries* enter the lung on the air tube, and supply offsets to those tubes and the contiguous bronchial glands, to the large bloodvessels, and to the interlobular connective tissue of the lung. The *bronchial vein* begins by roots corresponding to the branches of the artery; except on the smallest divisions of the air tubes, where the capillaries communicate with the pulmonary vessels—most probably the arteries. and bronchial artery and vein.

Nerves and lymphatics.—The lung receives *nerves* from the vagus and the sympathetic, and the offsets follow the divisions of the air tube. Remak describes small ganglia on the sympathetic filaments. The *lymphatics* of the lung are both superficial and deep, and enter the bronchial glands at the root of the lung. Nerves. Lymphatics.

PARTS IN FRONT OF THE SPINE AND THE CORD OF THE SYMPATHETIC.

In front of the spinal column are the several parts enumerated as lying in the interpleural space of the posterior half of the mediastinum, viz. the aorta, azygos veins, thoracic duct, and œsophagus.

Dissection.—The small thoracic duct should be first found near the diaphragm, and on the right of the aorta: this slender vessel may be injected with tallow. Next, the connective tissue is to be cleared away from the different parts before mentioned, and the thoracic duct to be followed upwards beneath the arch of the aorta and along the œsophagus, till it leaves the upper aperture of the thorax. The azygos or intercostal veins, one on the right, and two on the left of the aorta, should be likewise dissected. Dissection of the parts above mentioned,

After raising the pleura from the inner surface of the thorax, the gangliated cord of the sympathetic nerve will be seen lying along the side of the spinal column, over the heads of the ribs. Branches should be followed outwards from the ganglia to the intercostal nerves, and others should be traced inwards over the bodies of the vertebræ to form the three trunks of the splanchnic nerves. and of sympathetic.

Thoracic aorta. Extent, course, and connections.

The THORACIC AORTA is the part of the great systemic vessel, which is above the diaphragm. Its extent is from the lower border of the third dorsal vertebra (the left side), where the arch ceases, to the front of the last dorsal vertebra. Contained in the interpleural space in front of the spine, the vessel is rather arched in its course, lying at its upper part on the left, but at its lower part on the front of the spinal column; beneath it are the vertebræ and the smaller azygos vein. In front of the vessel is the root of the left lung with the pericardium. On the left side it is covered by the pleura in all its length; and on the right side are the œsophagus and the thoracic duct, but near the diaphragm the former is placed over the aorta.

Branches.

The *branches* of the vessel are distributed to the surrounding parts, and are named from their destination, viz. bronchial, pericardial, œsophageal, mediastinal, and intercostal.

Arteries of the lung. Distribution.

1. The *bronchial arteries* supply the structure of the lungs, and arise from the front of the aorta, but their number and place of origin are liable to vary. These vessels adhere to the posterior part of the bronchial tubes, and so enter the interior of the lung, in which they ramify (p. 385.); they give some twigs to the bronchial glands and the œsophagus.

One right,

The artery of the right lung arises either in common with one of the left bronchial arteries (superior), or from the first intercostal artery of the right side.

two left.

For the left lung there are two arteries (superior and inferior), that arise from the aorta at a distance from each other.

Vein of the lung.

Bronchial veins. — One vein issues from the root of each lung, to end in the following manner: — the right one joins the larger azygos vein; and the left ends in the superior intercostal vein of its own side.

Pericardial branches.

2. The *pericardial*[*] *branches* are some irregular twigs that are furnished to the posterior part of the cardiac covering.

Œsophageal branches.

3. *Œsophageal branches* arise at different points of the aorta, and are four or five in number. Ramifying in the structure of the gullet, these vessels anastomose with one another; above, they communicate with branches of the

inferior thyroid artery near the pharynx, and below, with twigs of the coronary artery of the stomach.

4. Small *mediastinal branches* (posterior) supply the connective tissue and the glands in the posterior part of the interpleural space. Mediastinal branches.

5. The *intercostal arteries* are commonly ten or nine in number on each side, and are furnished one to each of the lower intercostal spaces. To the other one or two upper spaces branches are supplied from the intercostal artery of the subclavian trunk. These small vessels arise from the posterior part of the aorta, and run outwards on the vertebræ, beneath the cord of the sympathetic nerve, to the intercostal spaces, where each divides into an anterior and a posterior branch. In this course the upper arteries have a somewhat oblique, and the lower a transverse direction. As the aorta lies on the left of the spine, the right vessels are the longest, and pass beneath the œsophagus, the thoracic duct, and the azygos veins; they supply many twigs to the bodies of the vertebræ on which they lie. Intercostal arteries. Number. Direction to the intercostal spaces. Right, longest.

a. The *anterior branch* is the continuation of the common trunk in direction and size. At first this artery lies in the centre of the intercostal space, beneath the pleura and a fascia between the intercostal muscles, and resting on the external intercostal layer. But near the angle of the rib it ascends to the upper limit of the space, and then continues onwards between the muscular strata nearly to the anterior third of the intercostal space, where it ends in two branches that anastomose with the intercostal arteries of the internal mammary (p. 266.). Accompanying the artery are the intercostal nerve and vein, — the vein being commonly above, and the nerve below it; but in the upper spaces the nerve is at first higher than the artery, though it soon takes its place below that vessel. Branches are furnished to the layers of intercostal muscles and the ribs: about the centre (from front to back) of the intercostal space a superficial twig accompanies the cutaneous nerve. The anterior branch occupies intercostal space with nerve and vein. Offsets.

The upper artery of the set anastomoses with the superior intercostal branch of the subclavian artery; and those below the true ribs enter the abdominal wall, and anastomose in it with the arteries of that part. Anastomoses.

b. The *posterior branch* turns backwards between the vertebra and the ascending costo-transverse ligament, and is distributed in the back. As it passes by the intervertebral foramen it furnishes Posterior branch turns to the back.

a small spinal branch to the vertebræ and the spinal cord. — (See VESSELS OF THE SPINAL CORD.)

Inter-costal vein. The *intercostal vein* closely resembles the artery in its course and branching. Near the head of the rib it receives a contributing dorsal branch, and then joins an azygos vein.

Superior inter-costal artery from subclavian. Supplies one or two spaces. The *superior intercostal artery* of the subclavian trunk is referred to in the dissection of the neck (p. 75.). Descending over the neck of the first rib, external to the ganglion of the sympathetic, it supplies a branch to the first intercostal space: continuing to the second space, which it may supply in like manner, it ends by anastomosing with the upper aortic branch. Each intercostal offset from it divides into an anterior and a posterior branch, like the arteries from the aorta.

The vein on the right and on left side. The *vein* corresponding to the right artery opens into the innominate vein. On the left side the superior intercostal vein is formed by branches from the two or three highest spaces; it is joined by the left bronchial vein, and ends in the left innominate vein, after crossing the arch of the aorta.

Two or three azygos veins. The PREVERTEBRAL OR AZYGOS VEINS are one or two in number on the left side, and one on the right, and receive branches corresponding to the offsets furnished by the descending part of the thoracic aorta. By means of the larger or right vein, the inferior cava communicates with the superior, so that blood may reach the heart from the lower part of the body or *vice versâ*, if one of the cavæ should be obliterated.

Large azygos is on right side of spine, The *larger* or right *azygos vein* begins in the lumbar veins on the right side of the spine, and its origin is described with the vessels of the abdomen. It enters the thorax through the aortic opening of the diaphragm, and ascends on the right side of the thoracic duct, over the intercostal arteries and the bodies of the vertebræ. and joins superior cava. Opposite the third intercostal space, the vein arches forwards above the root of the right lung, and enters the superior cava as this vessel pierces the pericardium. Its valves are very incomplete, so that the intraspinal and intercostal veins may be injected through it.

Branches joining it. *Branches.* — In this vein are collected the intercostals of the right side below the upper two spaces; some of the intercostals of the left side of the thorax, by means of the

left azygos veins; some œsophageal, mediastinal, and vertebral veins, and the right bronchial vein.

The left lower or *smaller azygos vein* (inferior) begins in the abdomen, in the lumbar veins of the left side of the vertebral column. Having entered the thorax along with the aorta, or through the crus of the diaphragm, the vein ascends on the left of the aorta as high as the seventh or eighth dorsal vertebra, and then crosses beneath that vessel and the thoracic duct to end in the larger or right vein. It receives the four or five lower intercostal veins of the left side, and some œsophageal and mediastinal veins.

Small, or left lower, begins in abdomen, ends in larger azygos. Branches.

Most commonly there is a *left upper* azygos vein (M. Breschet), which is formed by offsets from the spaces between the superior intercostal vein and the highest branch of the left lower azygos. Receiving three or four branches, the trunk either joins the lower azygos of its own side, or crosses the spine to open separately into the right vein.

Another left azygos vein (upper).

The ŒSOPHAGUS is a hollow muscular tube which extends from the pharynx to the stomach. The cervical part of the tube has been described at page 128., and the thoracic part is now to be examined.

Œsophagus is partly in neck

Entering the thorax rather to the left of the middle line, the gullet is directed inwards beneath the arch of the aorta, and reaches the middle of the spine about the fourth or fifth dorsal vertebra. From that spot it is continued through the greater part of the interpleural space on the right of the aorta, and superficial to the other contiguous bodies; but at the lower part of the thorax, it is again inclined to the left, over the aorta, to gain the œsophageal opening of the diaphragm. As far as the arch of the aorta the œsophagus lies beneath the trachea, though it is inclined somewhat to the left of the air tube: but beyond the arch it is crossed by the left bronchus, and is concealed by the pericardium, down to the diaphragm. In this extent the tube is covered on the sides by the pleuræ, and lies, below the arch, on the right of the aorta. At the upper part of the thorax the œsophagus will be found to rest on the longus colli muscle and the vertebræ; but below the arch of the aorta it is separated from the spine by the intercostal vessels, and lastly it lies on the aorta. Below the situation of the bronchus the pneumogastric nerves surround the œsophagus with their branches,

and partly in the thorax, where it lies in front of the spine, passes through diaphragm.

Parts covering it, on the sides, and beneath.

and above the same spot the thoracic duct will be found to the left of the tube.

Three coats are in it.

Structure. — If a piece of the middle of the gullet be removed and distended with cotton wool, it will be found to consist of a muscular, a fibrous, and a mucous coat.

A muscular coat of

The *muscular coat* is thick and strong, and consists of two layers of fibres; the external of these is longitudinal, and the internal circular in direction, like the muscular tunic of the other parts of the alimentary tube. In the upper third of the œsophagus the fibres are red, and have the striated or voluntary muscular fibres mixed with the involuntary; but below this the striated fibres gradually disappear, the colour becoming paler with their absence, and then only involuntary muscular fibres remain.

voluntary and involuntary fibres.

External longitudinal attached to tendinous points

The *external layer* is formed of parallel longitudinal fibres, which form an entire covering, and end below on the stomach. The fibres begin by longitudinal bands opposite the cricoid cartilage (p. 139.); and at intervals varying from half an inch to an inch and a half, they are connected with tendinous points ($\frac{1}{20}$th to $\frac{1}{10}$th of an inch long, and $\frac{1}{30}$th wide) like the fibres of the rectus abdominis muscle.

and internal circular fibres.

The *internal layer* of circular fibres is continuous above with the fibres of the pharynx; these are more oblique at the middle than at either end of the œsophagus.

Fibrous coat.

The *fibrous layer* is between the muscular and mucous coats, and attaches one to another loosely.

Mucous coat.

The *mucous coat* or lining will be seen on cutting open the tube to be reddish in colour above, but pale below, and of some thickness. It is very loosely connected with the muscular coat, and is thrown into longitudinal folds when the œsophagus is contracted. Lining the interior is a thick layer of scaly epithelium, and the surface is studded with minute papillæ.

Some glands.

Some *compound glands* (œsophageal) are scattered along the tube; and at the lower part of the gullet they form a ring (cardiac glands) close to the stomach.

In the thorax, lymphatic glands and duct.

Lymphatics of the Thorax. — In the thorax there are the lymphatic vessels of both the wall and the viscera, which enter collections of glands in certain positions, and end in either the one or the other of the two lymphatic ducts.

Besides these, the large thoracic duct traverses the thorax in its course from the abdomen to the neck.

a. Lymphatic glands.—Along the course of the internal mammary artery is a chain of *sternal* or mediastinal glands, which receive lymphatics from the front of the chest, the thymus gland, the pericardium, and the upper surfaces of the diaphragm and liver. On each side of the spine, near the heads of the ribs as well as between the intercostal muscles, is a set of *intercostal* glands, that receives the lymphatics of the posterior wall of the thorax. At the division, and along the side of the trachea are numerous *bronchial* glands, through which the lymphatics of the lung pass. And beneath the arch of the aorta are a few *cardiac* glands, which receive the lymphatics of the heart. Along the side of the aorta and œsophagus is a chain of *œsophageal* glands, which are joined by the lymphatics of the œsophagus, and communicate with those of the lungs. Several sets of glands, into which the lymphatics are collected.

b. The *thoracic duct* is the great channel by which the lymphatic and lacteal fluid of all the lower half of the body, and that of the left side of the upper half of the body, is conveyed into the blood. The duct begins in the abdomen in an enlargement (chyli receptaculum), and ends in the left subclavian vein of the neck. It is from eighteen to twenty inches in length, and is contained in the thorax, except at its origin and termination. It has the undermentioned connections:—Entering the cavity on the right side of the aorta and through the same opening, the duct ascends on the right of that vessel, between it and the vena azygos, as high as the arch. Opposite the second dorsal vertebra it passes beneath the arch of the aorta and the left subclavian artery, and is applied to the left side of the œsophagus, by which it is conducted to the neck. Lastly, at the lower part of the neck, the duct arches outwards, as before described (p. 125.), to open into the left subclavian vein. In this course the tube is oftentimes divided in two, which unite again, or its divisions may even form a plexus; and near its termination it is generally branched. It is provided with valves at intervals, like a vein, and these are in greater number at the upper than at the lower part. Occasionally the duct may be found on the left instead of the right side of the aorta.

Thoracic duct begins in the abdomen and ends in neck.

Connections in the thorax.

May be divided.

Is furnished with valves.

Receives lymphatics. *Branches.*— In the thorax the duct receives the lymphatics of the left half of the wall of the cavity, viz. from the sternal and intercostal glands; also, the lymphatics of the left lung, those of the left side of the heart, and those of the trachea and œsophagus.

Right duct is in the neck. *c.* The *right lymphatic* duct, though not in the thorax, is mainly formed by the large branches received from the viscera in that cavity. It is a short trunk at the lower part of the neck, which is about half an inch in length, and opens into the angle of union of the subclavian and jugular veins of the same side (p. 76.). Its opening is guarded by valves.

It receives lymphatics of the arm and of the thorax. *Branches.*— Into this trunk the lymphatics of the right upper limb, and the right side of the head and neck pour their contents. In addition, the lymphatics of the right side of the chest, those of the right lung and the right side of the heart, and some from the right lobe of the liver, after passing through their respective glands, unite into a few large trunks that ascend beneath the innominate vein to reach the duct in the neck.

Their structure like bloodvessels. *Structure of the ducts.*— The wall of these tubes resembles in structure that of the bloodvessels:— it has an external stratum of areolar tissue; an inner lining of thin nucleated epithelium; and a middle coat formed chiefly of circular fibres like those in the bloodvessels.

Thoracic cord of sympathetic has twelve ganglia, Cord of the Sympathetic Nerve.— The thoracic part of the gangliated cord of the sympathetic nerve lies on each side of the spinal column, and is placed over the heads of the ribs and the intercostal vessels. The ganglia on it are usually twelve, one being opposite each dorsal nerve, but this number varies much: of these, the upper one is the largest; and the last two are rather anterior to the line of the others, being situate on the side of the bodies of the corresponding vertebræ. In the chest the sympathetic nerve is covered by the pleura; and it is continuous above and below with the cord in the neck and the abdomen.

and is covered by pleura.

Branches Each ganglion furnishes external branches to communicate with the spinal nerves, and internal branches for the supply of the viscera.

to join the spinal nerves *Connecting branches.*— Two offsets pass outwards from each ganglion to join a spinal nerve (intercostal). In the branches of communication both spinal and sympathetic

nerve fibres are combined; but one consists almost entirely of white, and the other nearly altogether of sympathetic nerve fibres.

The *internal branches* differ in size and distribution, according as they are derived from the upper or the lower six ganglia. to supply viscera.

The *branches* of the *upper six* are very small, and are distributed to the aorta, and the vertebræ and their ligaments. Mr. Swan describes a plexus in front of the spine, as formed by the union of the branches of opposite sides. From the third and fourth ganglia offsets enter the posterior pulmonary plexus. In the upper six ganglia offsets are small.

The *branches* of the *lower six* ganglia are larger and much whiter than the others, and are united together to form visceral nerves (splanchnic) of the abdomen. These splanchnic nerves are three in number (large, small, and smallest), and pierce the diaphragm to end in the solar and renal plexuses. In the lower six, large and white, and form three nerves.

a. The *great splanchnic nerve* is a large white cord, which arises by roots apparently from only four or five ganglia (sixth to the tenth), but its fibres may be traced upwards on the knotted cord as high as the third ganglion. The nerve descends on the bodies of the vertebræ, pierces the fibres of the crus of the diaphragm, and ends in the semilunar ganglion of the abdomen.—(See NERVES OF THE ABDOMEN.) Great splanchnic, which ends in semilunar ganglion.

At the lower part of the thorax the nerve may be divided into large bundles; and it may present a ganglion, or more than one, on its different bundles.

b. The *small splanchnic nerve* is formed by roots from the tenth and eleventh ganglia, or their intervening cord: and in the thorax it communicates sometimes with the great splanchnic nerve. It is transmitted inferiorly through the crus of the diaphragm, and enters the part of the solar plexus by the side of the cœliac artery. Small splanchnic joins cœliac plexus.

c. The *smallest splanchnic nerve* begins in the last ganglion, and accompanies the other nerves through the diaphragm. In the abdomen it ends in the renal plexus. When this nerve is absent, its place is taken by a branch of the preceding nerve. Smallest splanchnic ends in renal plexus.

Parts in the upper aperture of the thorax.—The relative Position of parts

in the upper aperture. position of the several bodies that enter or leave the thorax by the upper opening may be now studied.

In middle line. In the middle line lie the trachea and the œsophagus, with the remains of the thymus gland. In front of those parts are the lower ends of the sterno-hyoid and sterno-thyroid muscles with layers of the fascia, and behind them is the longus colli muscle: between the two tubes is the recurrent nerve of the left side.

On each side. On each side, the bag of the pleura and the apex of the lung project into the neck; and between the pleura and the trachea and œsophagus, are found the several vessels and nerves that pass from the thorax to the neck, or in the opposite direction. At both sides, there is the innominate vein with the phrenic and pneumo-gastric nerves, but farther back the objects on the two sides are different:—thus, on the right side, come the innominate artery and the cardiac nerves; but on the left side, the left common carotid artery, the thoracic duct, and the left subclavian artery with the cardiac nerves. Lastly, altogether behind, on both sides, are the cord of the sympathetic, the first intercostal nerve, and the superior intercostal artery.

Partly the same on both sides, and partly not.

PARIETES OF THE THORAX.

Soft parts bounding the thorax. Between the ribs, forming part of the wall of the thorax, are the two layers of intercostal muscles, with the intervening nerves and arteries. At the base of the thorax is the diaphragm, which bounds the cavity in this direction.

Intercostal muscles. INTERCOSTAL MUSCLES. — The anterior part of these muscles has been described with the wall of the thorax in the dissection of the upper limb (p. 264.). The posterior part of the same muscles may be now examined from the inner side.

Inner layer The *internal intercostal muscle* is fixed to the inner margin of the ribs bounding the intercostal space. Beginning at the sternum, it reaches backwards only to the angle of the ribs in the middle spaces, but above and below the muscular fibres approach nearer the spine. Where the muscle ceases, a thin fascia is continued to the spine. The inner surface is lined by the pleura, and the opposite surface is in contact with the intercostal nerve and vessels.

reaches angle or head of the rib.

Connections.

Infracostal, The *infracostal muscles* are small slips of fleshy fibres,

that are situate on the inner surface of the ribs, where the internal intercostals cease. Apparently part of the inner intercostals, they arise from the inner surface of one rib, and are attached below to the upper border and internal surface of the rib next succeeding. They are uncertain in number, but there may be ten: they are smaller above than below, and the upper and lower may pass over more than one space. position, attachments, irregularities.

External intercostal muscle. — Between the posterior border of the internal muscle and the spine, when the fascia and the muscles above referred to have been removed, the external intercostal muscle will be seen. Its attachments are connected above and below with the margins of two contiguous ribs, and its fibres cross those of the internal muscular layer. Whilst this muscle extends backwards to the tubercle of the rib, it does not reach farther forwards than the rib cartilages, as before seen (p. 265.). Outer layer extends back to head of the rib.

Dissection. — In a few spaces the internal intercostal muscle may be cut through, and the intercostal nerve and artery traced outwards. Trace nerves.

The INTERCOSTAL NERVES are the anterior primary branches of the dorsal nerves. In distribution they differ from the other spinal nerves of the body, inasmuch as they course forwards almost horizontally to the middle line without being united in a plexus. Twelve in number, they occupy the intercostal spaces, except the last which is below the twelfth rib. The following difference obtains between the upper and the lower nerves, viz. that the upper six lie between the ribs in all their extent, and are confined to the wall of the thorax, whilst the lower six are contained in part in the abdominal wall in front of the line where the ribs cease. Intercostal nerves are not joined in a plexus. Upper six are in the spaces; lower six leave them in front.

At the posterior part of the chest the nerves are seen to lie at first between the pleura and the external intercostal muscle, with an artery and vein; but they soon enter between the two strata of the intercostal muscles, and extend forwards to the middle line of the body, as before said. Near the head of the rib each nerve is joined by filaments from the sympathetic. In its course it supplies branches to the intercostal muscles of the ribs; as well as cutaneous offsets to the surface, which are described in the dissec- Connections with muscles; with the sympathetic. Offsets.

tions of the upper limb (p. 250.) and the wall of the abdomen.

Exceptions in first two.

There are some deviations in the first and second nerves from the general arrangement above specified.

First nerve enters brachial plexus.

The *first nerve* ascends in front of the neck of the upper rib, and ends in the brachial plexus. Before it leaves the chest, it supplies a small branch to the first intercostal space; this extends forwards furnishing muscular offsets, and becomes cutaneous by the side of the sternum. But there is not any lateral cutaneous branch from this nerve, except in those cases in which the next nerve is not as large as usual.

Has not, usually, cutaneous branch.

Second nerve.

The *second nerve* may extend a considerable way on the wall of the chest before entering between the intercostal muscles, and may ascend even to the first space. It is remarkable in having a very large lateral cutaneous branch (p. 250.). In front it ends like the others.

Form of upper surface of diaphragm.

Upper surface of the diaphragm. — The anatomy of the diaphragmatic partition between the thorax and the abdomen will be specially described with the deep muscles of the latter cavity. The arch of the muscle towards the thorax has been before referred to (p. 342.): the centre of the arch is tendinous, but the sides are fleshy. In contact with the upper surface are the lungs, one on each side, and the pericardium in the middle. In the muscle are the following apertures: — one for the œsophagus and the pneumogastric nerves, another for the vena cava, and a third for the aorta with the thoracic duct and the vena azygos. The phrenic vessels and nerves enter the upper surface, external to the pericardium; and the splanchnic nerves are transmitted to the abdomen through the posterior part, whilst the sympathetic passes beneath it.

Parts in contact with it.

Apertures in it.

The dissection of the back is now made.

Directions.—The dissector of the thorax now waits while the dissection of the back is made. Afterwards he is to examine the ligaments of the ribs, and those of the spine: a notice of these will be found in the following section.

Section II.

LIGAMENTS OF THE TRUNK.

The ligaments connecting the vertebræ, those uniting the ribs to the spinal column and the sternum, and the pieces of the sternum one to another, are described in this section. Enumeration of the ligaments.

Articulation of the Ribs. — The sternal rib is united to the vertebræ on the one side, and to the sternum on the other, by three sets of ligaments, viz. one between the head of the bone and the bodies of the vertebræ; a second from its neck and tubercle to the transverse processes of the vertebræ; and a third between its cartilage and the sternum. The asternal ribs will want the last articulation. A rib is united with the vertebræ and the sternum.

Dissection.—For the purpose of examining the ligaments between the head and neck of the rib and the vertebræ, take a piece of the spinal column with three or four ribs attached. After removing the intercostal muscles and the fibrous tissue from the surface of the bones, the student will be able to define the following under-mentioned ligaments passing to the spinal column and the transverse processes. To see ligaments to the vertebræ.

The ligaments attaching the costal cartilage to the rib and the sternum are to be dissected on the part of the anterior wall of the thorax that was removed in opening the thoracic cavity. To rib and sternum.

A. *Ligaments from the head of the rib.*—The head of the rib is received into a hollow on the side of the bodies of two contiguous vertebræ, except in the first, eleventh, and twelfth ribs; and the articulation is provided with two retaining ligaments — costo-vertebral and interarticular, and two synovial sacs. Ligaments of head of rib are

The *costo-vertebral ligament*, which is also named *stellate* from its form, is composed of radiating fibres, and fixes the ribs to the vertebræ. In those ribs that touch two vertebræ it consists of three sets of fibres: — the upper set, the largest, is attached to the body of the vertebra above the rib; the lower one descends to the inferior of the two vertebræ with which the head articulates; and the central part is united with the fibro-cartilage between those vertebræ. Where the rib is articulated with one vertebra, as in the costo-vertebral or stellate, differs in vertebræ

first, eleventh, and twelfth, this ligament is limited also to the one centrum.

inter-articular

The *interarticular ligament* will be seen when the stellate ligament is divided. It is a short thin band of fibro-cartilage, which is attached on one side to the ridge separating the articular surfaces on the head of the rib, and becomes blended by the other end with the fibro-cartilaginous substance between the vertebræ. In the first, eleventh, and twelfth ribs it is absent.

with two sacs.

Synovial sacs. — There are two sacs in the articulation, one on each side of the interarticular ligament, except in the three ribs before mentioned, where there is but one.

Ligaments of neck of rib,

B. *Ligaments from the neck and tubercle of the rib.* — Three ligaments (costo-transverse) pass from the neck and tubercle of the rib to the transverse processes. And there is one synovial sac between the rib and its transverse process.

anterior costo-transverse.

The *anterior costo-transverse* ligament is larger and longer than the others; it ascends from the upper border of the neck of the rib to the lower edge of the transverse process of the upper of the two vertebræ with which the head of the rib is connected. It is wanting necessarily in the first rib. Between this ligament and the vertebræ the posterior branches of the intercostal artery and dorsal nerve pass backwards; and by the outer edge it is continuous with the fibrous membrane between the strata of the intercostal muscles.

Posterior costo-transverse.

The *posterior costo-transverse* is placed at the posterior aspect of the rib. It is a short band of fibres between the tip of the transverse process of each vertebra and the rough part of the tubercle of the rib. This band is longest on the lowest two ribs.

Middle costo-transverse.

The *middle* or *interosseous costo-transverse* is placed horizontally between the neck of the rib and the transverse process with which the tubercle articulates. It will be best seen by sawing horizontally through the rib and the transverse process. Its fibres are mixed with reddish connective tissue.

Synovial sac.

If the posterior ligament is divided, a *synovial membrane* will be found in the joint, but this is absent in the lowest

two ribs, where the tubercle and the transverse process do not touch.

C. *Ligaments from the cartilages of the ribs.*—The costal cartilages of the true ribs are united to the sternum by anterior and posterior ligaments, which cover a synovial membrane; and they are further joined externally to the bony part of the rib. Some of the lower cartilages touch each other, and are connected together by fibrous bands and synovial membrane. Union of the costal cartilages

a. In the *chondro-sternal articulation*, the cartilages of the true ribs are received into the depressions on the side of the sternum, and are fixed in their position by surrounding fibres, but chiefly in front and behind, where these give rise to an *anterior* and a *posterior ligament.* Between the cartilage and the articular surface of the bone is a *synovial* membrane. A separate band of fibres passes between the cartilage of the seventh rib and the xiphoid cartilage, and is named *costo-xiphoid ligament.* with the sternum;

b. Costal cartilage with the rib.—The bony part of the rib is hollowed to receive the costal cartilage, and the only investing membrane between the two is that of the periosteum of the rib. with the rib;

c. One costal cartilage to another.—The contiguous surfaces of the costal cartilages, from the sixth to the ninth, are connected by ligamentous fibres, and the articulations are provided with synovial membranes. with one another.

Articulation of the Pieces of the Sternum.—The upper piece of the sternum is connected to the lower by anterior and posterior longitudinal fibres, and between them is an intervening cartilage. Union of pieces of sternum.

Articulation of the Vertebræ.—The several separate vertebræ composing the spinal column are united together by two sets of ligaments—one between the bodies and the other between the processes of the bones. Two sets of ligaments unite the vertebræ.

These ligaments have a general resemblance along the spinal column, and one description will suffice for all except for those between the first two vertebræ and the head, and those between the bones of the pelvis. The description of the special ligaments, thus excepted, will be found in the dissection of the neck (p. 182.) and in that of the ligaments of the pelvis.

How to see the several ligaments.

Dissection.— After the dissection of the ligaments of the ribs, the same piece of the spinal column will serve for the ligaments of the bodies and articular processes of the vertebræ. It is supposed that the spinal canal has been opened to examine the spinal cord, and that the posterior ligament of the bodies of the vertebræ is therefore laid bare, but if the canal should not be opened, the arches of the vertebræ must be sawn through close to the articular processes. The anterior ligament of the bodies will be prepared with very little trouble, by only removing the connective tissue.

The remaining ligaments between the neural arches and the spines of the bones may be defined on those pieces that have been taken away in opening the spinal canal.

The bodies are united by:

A. *Ligaments of the bodies of the vertebræ.*— The bodies of the vertebræ that remain separate are united by an anterior and a posterior common ligament, and by intervening pieces of fibro-cartilage.

Anterior common ligament, varies in width,

The *anterior common ligament* is white and strong, and reaches from the atlas to the sacrum: it is widest opposite the lumbar vertebræ, and becomes narrower as it is traced upwards. Its fibres are longitudinal in direction, and consist of a superficial and a deep layer: by detaching parts of the ligament, the superficial fibres will be seen to reach the length of three or more vertebræ, whilst the deep reach from bone to bone. A greater number of the fibres are attached to the intervertebral fibro-cartilages than to the bones; and more are fixed to the margins than to the centre of the body of a vertebra. Its outline is uneven, for it is broader over the bodies of the vertebræ than on the intervertebral substance: and if the ligament be cut across at intervals it will be found to be thickest opposite the hollow part of the body of the vertebra.

length, and attachment of its fibres,

and in thickness.

Posterior common ligament is wide at parts;

The *posterior common ligament* is contained in the spinal canal, lying on the posterior aspect of the bodies of the vertebræ, and extends from the sacrum to the occipital bone. This ligament is wide above, and diminishes in size downwards, just the opposite of the anterior: in the neck it is loose, and extends all across the bodies of the vertebræ, whilst in the loins it is only a thin narrow band. Opposite the dorsal and lumbar intervertebral substance it is wider than at the centre of the bodies of the vertebræ, and sends off

on each side a pointed process to be attached to the pedicle of the neural arch, so that the margins are zigzag or dentate in those regions of the spine. Its fibres are superficial and deep as in the anterior ligament, and are more closely united with the intervertebral substance than with the bone. One surface of the ligament is in contact with the dura mater; and between the opposite surface and the vertebræ are the large veins issuing from those bones. attachment and connections.

Dissection.—To see the intervertebral substance, the anterior and posterior common ligaments must be taken away. One vertebra should be detached from the intervening fibro-cartilage to obtain a horizontal view of this structure; and two other vertebræ should be sawn vertically to see the difference in the consistence, and the arrangement of the laminæ. To see the intervertebral substance.

The *intervertebral substance* is placed between the contiguous surfaces of the bodies of the vertebræ, from the axis to the sacrum. Taking the shape of the vertebræ it forms an almost circular disc between those bones; it is connected in front and behind, with the anterior and posterior common ligaments, and, on the sides, with the stellate ligaments of the heads of the ribs. These masses are thicker between the lumbar and cervical, than between the upper dorsal vertebræ; and where the spinal column is arched forwards, as in the loins and neck, they are deepest at the anterior edge. Intervertebral substance has the shape of the bones, and gives some curves to the spine.

By means of the dissections before made, the intervertebral substance may be observed to consist of two distinct parts; an external, firm and laminar, and an internal, soft and elastic. Constituent parts;

The outer laminar part forms more than half of the disc, and is composed of a series of pieces of fibro-cartilage, alternating with layers of fibrous tissue. All the strata are arranged one within another, like the scales of an onion, and are connected by their edges to the bodies of the vertebræ; but all have not a vertical position between the vertebræ, for the external pieces are bent, so that the convexity is towards the surface, and the internal are convex towards the centre of the disc. The laminæ of the fibro-cartilage form complete rings less frequently than the layers composed of fibrous tissue. Each layer is constructed of oblique fibres, and the fibres of one layer are directed across those of another like the outer formed of laminæ; how arranged; not vertical; their fibres cross.

the parts of the letter X. This disposition of the fibres will be best seen on the discs between the lumbar vertebræ; and it may be rendered evident by dissecting layer after layer.

Inner part without marked strata; construction.

The central portion of the disc is very soft and elastic. and projects when two vertebræ and the interposed mass are sawn through. It has a yellowish colour, and is deficient in the stratiform arrangement so conspicuous at the circumference. Towards the confines of the two portions of the intervertebral substance, there is still an alternating arrangement of fibrous tissue and fibro-cartilage, though the former is gradually diminishing; but towards the centre a loose fibro-cartilaginous material preponderates, and amongst it are spaces containing much fluid.

Cartilage covering bones.

The surfaces of the vertebræ in contact with the discs, have a cartilaginous covering. This may be seen by cutting the intervertebral substance from the bone. Over the centre of the osseous surface it forms a continuous layer, but towards the circumference it consists of separate pieces.

Several ligaments of the vertebral processes.

B. *Ligaments of the processes of the vertebræ.* — The several processes of the vertebræ have special uniting ligaments: — thus the articular processes are joined by a capsular ligament and a synovial membrane; the neural arches are connected by yellow ligaments; the spinous processes have one band along the tip and another between their borders; and the transverse processes are provided with intervening bands of fibres.

To the articular, are capsule and sac.

a. *Ligaments of the articular processes.* — Between the articulating processes there is a moveable joint. The bones are covered with cartilage, and are surrounded by a loose *capsular* ligament of scattered fibres enclosing a *synovial* membrane. In the cervical region of the spine the capsular ligaments are larger and looser than in the dorsal or lumbar part.

Those of the arches are two to each space.

b. *Ligaments of the arches.* — The *ligamenta subflava*, so named from their colour, are situate between the neural arches of the vertebræ, and close the spinal canal behind. In the interval between the arches of two contiguous vertebræ are two somewhat square ligaments, one for each half of the arch, which approach one another along the middle line. Each consists of elastic yellow tissue, and is attached

Attachments.

above to the inner surface of the one arch, but below to the

upper border, and somewhat to the outer surface of the other. On each side the ligament reaches from the articular process to the root of the spinous process. Between the first two vertebræ and the skull there are special fibrous ligaments in the corresponding situation (see p. 182.).

c. Ligaments of the spines.—Along the tips of the spinous processes of the dorsal and lumbar vertebræ is a longitudinal band of fibres, — the *supraspinous* ligament. It is thicker in the lumbar than in the dorsal region of the spine, and is formed by superficial and deep fibres; the former reaching over three or more spines, whilst the latter pass from bone to bone. It is closely united with the tendons of the muscles. The band called ligamentum nuchæ, which is composed of fibrous tissue, takes its place in the neck.

Those of the spines are along their tip

Along the spinal column there are also thin and somewhat membranous *interspinous* ligaments, which reach from the root to the tip of the spinous processes. The strength of these bands is dependent upon the interval they have to fill; they are more marked in the lumbar than in the other vertebræ, but they are least strong in the cervical region.

and between the spines.

d. Ligaments of the transverse processes.— In the loins the *intertransverse ligaments* are thin membranous bands in the intervals between the processes. In the dorsal vertebræ they are round bundles of fibres. And in the neck the fibres exist only at the apex of the processes, or they may be wanting here and there.

Those of the transverse processes.

CHAPTER V.

DISSECTION OF THE BACK.

How the dissection is to be conducted. ACCORDING to the mode of dividing the body, the dissection of the back will in one school be allotted to one student; and in another school it will be undertaken conjointly by the dissectors of the head and the upper limbs,— one preparing the cervical, the others the dorsal and lumbar regions. If the last arrangement should be the one adopted as in this school, the dissector of the upper limb may give his attention only to those paragraphs that are marked with an asterisk; and the dissector of the neck may take specially the paragraphs which are not so marked.

Position of body. * *Position.*—For this dissection the body lies with the face downwards; and the trunk is to be raised by blocks beneath the chest and the pelvis, so that the limbs may hang over the end and sides of the dissecting table. To make tense the neck, the head is to be depressed and fastened with hooks.

Dissection * *Dissection.*—In the back the student will meet with successive strata of large muscles, five in all, amongst which vessels and nerves are interspersed.

to raise the skin. The first step in the dissection is to raise the skin from the surface in two flaps, by means of the following incisions: — One cut is to be made along the middle line of the body, from the occipital protuberance to the back of the sacrum: another incision is to be carried from the last dorsal vertebra to the acromion process of the scapula. The flap of skin above the last cut is to be turned outwards by both dissectors. The remaining piece of integument is to be detached by a transverse incision opposite the crest of the ilium, and then to be reflected by the dissector of the upper limb in the same direction as the other flap. Under the upper flap of skin is the trapezius, and underneath the lower one is the latissimus dorsi muscle.

Seek The cutaneous nerves may be now sought in the subcu-

taneous fatty layer. Small cutaneous arteries accompany the nerves, and guide the student to their position. These nerves vary much in size in the different parts of the back, and their number is also irregular: as a general rule, there is one corresponding to each vertebra. In the neck and opposite the upper part of the thorax, the nerves will be found near the spines of the vertebræ, and beneath the superficial fat; but over the lower part of the thorax, and in the loins, they issue in a line with the angles of the ribs. The cutaneous branches of the sacral nerves come into the dissection of the lower limb. Cutaneous nerves.

* Cutaneous Nerves.—The tegumentary nerves of the back are derived from the posterior primary branches of the spinal nerves; these subdivide amongst the deep parts into two branches, inner and outer, and the cutaneous offsets are derived at one spot from the external, and at another from the internal branch. Small arteries accompany the greater number of the nerves; these bifurcate like the nerves, and the cutaneous offsets are derived in the same way from the one or the other branch. Cutaneous nerves how derived.

Cervical nerves. — In the neck the nerves are derived from the inner of the two branches into which the primary trunks bifurcate: they perforate the trapezius, and supply the neck and the back of the head. They are four in number, viz. one from each nerve, except the first and the three last. The *branch* of the *second nerve* is named large occipital, and accompanies the occipital artery to the back of the head (p. 9.). The *branch* of the *third cervical nerve* supplies a transverse offset to the neck, and then bends upwards to the lower part of the head, where it is united with the great occipital nerve, and is distributed internal to it. In the neck.

* *Dorsal nerves.* — These are obtained from both the inner and the outer branches of the primary trunks — the upper six from the former, and the lower six from the latter. On the surface they are directed outwards in the integument over the trapezius and latissimus dorsi muscles. The *upper six* nerves perforate the trapezius near the spines of the vertebræ; and the branch of the second, which is larger than the rest, reaches as far as the scapula. The *lower six* nerves pierce the latissimus dorsi mostly in a line with the angles of the ribs; these are oftentimes uncertain in number. In the dorsal region.

* *Lumbar nerves.* — In the loins the nerves are derived from the outer branches of the primary trunks, and only from the first three; they perforate the latissimus dorsi muscle in a line with the In the loins.

outer border of the erector spinæ, and crossing the iliac crest of the innominate bone, are distributed in the integuments of the buttock.

Dissection. * *Dissection.*—The superficial fascia is now to be taken from the trapezius and latissimus dorsi in the direction of the fibres of each, viz. from the shoulder to the spinal column; and the upper limb is to be carried backwards or forwards according as it may be necessary to put on the stretch the different portions of the muscles. Some of the cutaneous nerves may be left, in order that they may be traced afterwards through the muscles to their origin.

Two muscles in first layer. * FIRST LAYER OF MUSCLES.—Two muscles, the trapezius and the latissimus dorsi, are present in this layer.

Trapezius. * The TRAPEZIUS MUSCLE is triangular in shape, with the base towards the spine, but the two muscles taken together have a trapezoid form. The muscle has an extensive aponeurotic *origin* along the middle line, from the head to the loins, viz. from the spines of the dorsal vertebræ and their supraspinous ligament; from the spinous process of the seventh cervical vertebra; from the ligamentum nuchæ between the last point and the head; and lastly from the inner third of the superior transverse ridge of the occipital bone. From this origin the fibres are directed outwards, converging to the shoulder, and are *inserted* into the outer third of the clavicle, at its posterior aspect; into the posterior border of the acromion; and into the upper edge of the spine of the scapula as far as to an inch of the root of that process, as well as into a rough impression on the surface of the spine at the hinder part. The muscle is subcutaneous. At its origin it is tendinous between the sixth cervical and the third dorsal vertebra, as well as at its attachment to the head; and at the outer side the lowest fleshy fibres end in a small triangular tendon, that glides over the smooth surface at the root of the spine of the scapula. The anterior border bounds behind the posterior triangular space of the side of the neck. By its insertion the trapezius corresponds to the origin of the deltoid muscle.

Origin aponeurotic.

Insertion fleshy.

Connections.

Trace spinal accessory. * *Dissection.*—The fibres of the trapezius are to be divided near the scapula, and over the spinal accessory nerve, so that the ramifications of that nerve in the muscle, and its junction with the branches of the cervical plexus may be

traced. A small artery to the trapezius (art. superficialis colli) accompanies the nerve.

The *spinal accessory nerve*, one of the trunks of the eighth pair of the cranial nerves (p. 118.), having crossed the posterior triangle of the neck, enters beneath the trapezius, and forms a plexiform arrangement with branches of the third and fourth nerves of the cervical plexus. The nerve is distributed to the muscle, and its filaments reach nearly to the lower border. Spinal accessory nerve in trapezius.

* *Dissection.* — To see the parts that are covered by the trapezius, this muscle is to be divided longitudinally, internal to the position of the spinal accessory nerve, and the two parts are to be thrown inwards and outwards. Dissection to reflect trapezius;

* The dissector of the upper limb should clean the fibres of the rhomboidei and levator anguli scapulæ muscles, which are fixed to the base of the scapula; and whilst this is being done, the scapula is to be drawn away from the trunk to make tense the fibres. to clean scapular muscles;

The dissector of the neck should define the parts beneath the clavicle, viz. the posterior belly of the omo-hyoid muscle with the suprascapular nerve and artery; the transverse cervical vessels; and the small branches of nerves to the levator anguli scapulæ, and the rhomboid muscles. If the trapezius be detached in the neck, the ligamentum nuchæ, from which it takes origin, will be brought into view. to dissect parts in the neck.

* *Parts covered by the trapezius.*—The trapezius conceals in the neck the splenius and a small part of the complexus, with the levator anguli scapulæ; and in the dorsal region it covers the following muscles — the rhomboidei, the erector spinæ, and the latissimus dorsi. As it reaches the scapula it lies over the supraspinatus muscle. Parts covered by trapezius.

The *ligamentum nuchæ* is a narrow fibrous band, that extends from the spinous process of the seventh cervical vertebra to the occipital protuberance. This structure serves as a partition between the muscles of opposite sides of the neck; and from the under part processes are sent down to be attached to the spines of the six lower cervical vertebræ. In man it is not formed of elastic tissue. Ligamentum nuchæ.

* The LATISSIMUS DORSI is thin, and is the widest muscle in the back; it is pointed and fleshy towards the humerus, but aponeurotic at its inner attachment or origin. It Latissimus dorsi is named from its shape.

Origin is tendinous except from some ribs. arises along the middle line from the spinous processes of the six lower dorsal, from those of all the lumbar, and from those of the upper two sacral vertebræ, as well as from the supraspinous ligament; along the outer side, by aponeurosis from the outer edge of the posterior half of the iliac crest, and by three or four fleshy processes from as many of the lower ribs, which digitate with pieces of the external oblique muscle of the abdomen; and between the outer and inner attachments it is inseparably blended below with the subjacent tendon of the multifidus spinæ. All the fibres converge to the inferior angle of the scapula, and after crossing that point of bone are continued forwards to be

Insertion into humerus. *inserted*, by means of a tendon, into the bottom of the bicipital groove of the humerus (p. 263.). The muscle is sub-

Connections. cutaneous, except a small part of the upper border which is covered by the trapezius; near the scapula there is a space between the two muscles, in which the ribs and the intercostal and rhomboid muscles are seen. The lower or anterior border overlays the edge of the external oblique muscle of the abdomen except a small part below, in the interval between the last rib and the crest of the ilium. Frequently the latissimus has a distinct fleshy slip from the inferior angle of the scapula.

Dissection to reflect latissimus. * *Dissection.*—The latissimus is to be divided about midway between the spines of the vertebræ and the angle of the scapula, and is to be reflected inwards and outwards. In raising the inner part of the muscle, care must be taken not to destroy the thin lower serratus with which it is united, and the aponeurosis continued upwards from the serratus. In the interval between the last rib and the iliac crest the latissimus is adherent to the aponeurosis of the transversalis abdominis muscle, and should not be detached from it.

Parts covered by the latissimus. * *Parts covered by the latissimus.* — The latissimus dorsi muscle lies on the erector spinæ, on the serratus posticus inferior, and on the lower ribs with their intercostal muscles. As it rests on the angle of the scapula, it conceals the teres major, and a part of the rhomboid muscle. Its relation to the teres is worthy of note: at the angle of the scapula it is in contact with the posterior surface of the teres, but nearer the humerus it turns round the muscle, and is inserted in

Forms front of it. Between the angle of the scapula and the

humerus the latissimus forms part of the posterior boundary of the axilla. axillary wall.

Dissection.—After the latissimus dorsi has been reflected, the dissector of the abdomen should examine the disposition of the posterior tendon of the transversalis abdominis (fascia lumborum) between the last rib and the innominate bone. Dissection of fascia lumborum;

In the spot referred to are parts of the abdominal muscles that have been left in the previous dissection. Firstly, a piece of the external oblique muscle may, or may not remain. After the removal of this muscle (supposing a part to be left), the internal oblique will be seen to be attached to a subjacent aponeurosis, and to the ribs and the iliac crest; its attachments above and below are to be cut through, and it is to be raised from the transversalis muscle, as far as it can be, towards the spine. Then the aponeurosis of the transversalis muscle (fascia lumborum) appears, and perforating it are two nerves:—one, the last dorsal, with an artery near the last rib; and the other, the ilio-hypogastric, close to the crest of the ilium. of muscles attached to it;

Two offsets are prolonged backwards from this fascia to the transverse processes. To see one prolongation, viz. the one that is attached to the apices of the processes, the latissimus dorsi is to be cut through (both its aponeurosis and fleshy part) by an incision directed outwards from the middle line, on a level with the spinous process of the third lumbar vertebra; on raising the outer border of the muscle (erector spinæ) which comes into view, the strong process of the fascia will be apparent. After dividing transversely this first prolongation, another muscle (quadratus lumborum) will be seen: and on raising its outer border the second thin offset of the fascia will be evident on the abdominal aspect of that muscle. of processes from it.

The *fascia lumborum* is the posterior aponeurosis of the transversalis abdominis muscle, and occupies the interval between the last two ribs and the crest of the ilium. By its cutaneous surface it gives attachment to the internal oblique muscle, sometimes to the external oblique, and to the aponeurosis of the latissimus dorsi and serratus posticus inferior. The last dorsal and ilio-hypogastric nerves pierce the aponeurosis in their course from the abdomen. From Fascia lumborum is part of transversalis abdominis;

the inner part of the aponeurosis two prolongations reach the transverse processes of the lumbar vertebræ, and enclose the quadratus lumborum. The more superficial of the two is the strongest; it passes beneath the erector spinæ in this position of the body, and is connected to the apices of the transverse processes, but it also fills the intervals between those pieces of bone. The deeper or anterior prolongation passes on the abdominal surface of the quadratus lumborum, to be fixed to the roots of the transverse processes, and to the bodies of the vertebræ. Thus the prolongations of the fascia contain the quadratus lumborum in a sheath. In like manner the erector spinæ lies in another sheath, which is formed by the vertebral aponeurosis and the tendons of the latissimus and serratus on the one side, and by the posterior of the two prolongations of the fascia lumborum on the other.

has two offsets behind, one to apex, the other to root of transverse processes; which form sheaths for muscles.

Second muscular layer.

* Second Layer of Muscles. — This stratum contains the elevator of the angle of the scapula, and the large and small rhomboid muscles. Besides these, there will be found in the neck the posterior belly of the omo-hyoid muscle, with some vessels and nerves that turn backwards towards the scapula.

Elevator of angle of scapula.

* The levator anguli scapulæ arises by tendinous slips from the tips of the transverse processes (diapophyses) of the three or four upper cervical vertebræ. The fibres form rather a roundish muscle, and are *inserted* into the base of the scapula between the spine and the superior angle. At its origin the muscle is beneath the sterno-mastoideus, and at its insertion, beneath the trapezius; the rest of the muscle appears in the posterior triangular space of the neck. Beneath it are some of the other cervical muscles (splenius colli and cervicalis ascendens).

Attachments and connections.

Rhomboid muscles are two.

* Rhomboidei Muscles. — The thin muscular layer of the rhomboidei, that is attached to the base of the scapula, consists of two pieces, large and small, separated by a slight interval.

Small muscle.

* The *rhomboideus minor* is a small narrow band, that *arises* from the spinous processes of the seventh cervical and first dorsal vertebræ, and from the ligamentum nuchæ; it is *inserted* into the base of the scapula, opposite the smooth surface at the root of the spine of that bone.

Attachments.

Large muscle. Origin.

* The *rhomboideus major* is larger than the preceding by the width of three or more spinous processes. It *arises* from the spines of the four or five upper dorsal vertebræ below the rhomboideus minor, and from the supraspinous ligament; and its fibres are directed outwards to be fixed to the base of the scapula between the spine and the lower angle. Sometimes all the fibres do not reach directly the scapula, but some end on a tendinous arch near the bone. These muscles are covered chiefly by the trapezius and the latissimus, but a portion of the larger rhomboid muscle is subcutaneous near the angle of the scapula.

Insertion.

Connections.

Posterior belly of omo-hyoideus.

Origin and termination.

The OMO-HYOID MUSCLE consists of two fleshy bellies, anterior and posterior, which are united by an intervening tendon (p. 67.). Only the posterior half is now seen. The muscle *arises* from the upper border of the scapula, behind the notch, and from the ligament that converts the notch into a foramen. The fibres form a thin riband-like muscle, which is directed forwards across the lower part of the neck, and ends anteriorly in the tendon beneath the sterno-mastoideus. The fleshy belly of the muscle is placed partly beneath the trapezius; and is partly superficial in the posterior triangular space of the neck, where it lies above the clavicle and the subclavian artery. It lies on the brachial plexus, and, near the scapula, on the suprascapular vessels and nerve.

Connections.

Suprascapular artery of the subclavian

The *suprascapular artery* is a branch of the subclavian trunk (p. 74.), and is directed almost horizontally outwards across the lower part of the neck to the back of the scapula. The vessel lies behind the clavicle, and courses along that bone, with the suprascapular nerve, but beneath the trapezius and omo-hyoid muscles, to the supraspinal fossa of the scapula. Before entering the fossa it furnishes a small branch (supraacromial) to the upper surface of the acromion.

ends on back of scapula.

Suprascapular nerve

The *suprascapular nerve* is an offset of the brachial plexus (p. 77.), and is inclined backwards to the superior costa of the scapula. It passes through the notch in the superior costa of the bone, and beneath the supraspinatus muscle; its termination in the muscles on the dorsum of the scapula will be seen in the dissection of the arm (p. 276.).

accompanies artery.

Transverse cervical artery of

The *transverse cervical artery* is also a branch of the subclavian, and has the same direction as the suprascapular

the subclavian branch, viz. towards the upper part of the scapula, but it is placed at a greater height above the clavicle. Crossing the upper part of the space in which the subclavian artery lies, divides into this branch passes beneath the trapezius, and divides into the two following branches — superficial cervical and posterior scapular: —

superficial cervical and *a.* The *superficial cervical branch* is distributed chiefly to the under surface of the trapezius, though it furnishes offsets to the levator anguli scapulæ and the cervical glands.

posterior scapular. *b.* The *posterior scapular branch* crosses beneath the elevator of the angle of the scapula, and turns downwards along the base of that bone beneath the rhomboid muscles. If these muscles are divided, the artery will be seen to furnish branches to them; and to give anastomotic twigs to both surfaces of the scapula, which join the other arteries distributed on the bone. This artery arises, very frequently, as a separate branch from the third part of the subclavian trunk.

Accompanying veins. The *veins* have the same name and course as the arteries above described; they open into the external jugular vein near its junction with the subclavian vein.

Nerve of rhomboid muscle. *Nerve to the rhomboid muscles.* — This slender nerve of the brachial plexus (p. 77.) takes the same course as the preceding artery, beneath the elevator of the angle of the scapula. Before its termination it supplies one or two twigs to the elevator of the scapula; it is lost in the rhomboidei, on their under surface.

Dissection. * *Dissection.* — By reflecting the rhomboidei muscles towards the spinous processes, and removing the loose connective tissue, the thin upper serratus muscle which is beneath them will be laid bare.

Third layer of muscles. * THIRD LAYER. — In this stratum are the following muscles: — the serratus posticus superior and inferior, with the splenius.

Serrati are two in number. * The SERRATI muscles are very thin, and receive their name from their toothed attachment to the ribs. They are two in number, superior and inferior, and have aponeurotic origins from the spines of the vertebræ.

Smaller one at upper part of the thorax. * The *serratus posticus superior* arises from the ligamentum nuchæ, and from the spinous processes of the last cervical, and the two or three upper dorsal vertebræ. The fleshy fibres are inclined downwards, and are attached by

slips to the second, third, and fourth ribs, external to their angles. The muscle rests on the splenius.

* The *serratus posticus inferior* occupies the lumbar region, and is wider than the preceding muscle. Its aponeurosis of *origin* is inseparably united with that of the latissimus dorsi and the fascia lumborum, and is connected to the spinous processes of the last two dorsal and the first three lumbar vertebræ. The fleshy fibres ascend to be inserted by offsets into the four last ribs in front of their angles, each successive process extending further forwards than the one below. This muscle lies on the mass of the erector spinæ, and with it the vertebral aponeurosis is united.

Larger muscle at lower part of thorax.

Connections.

* The *vertebral aponeurosis* is a fibrous expansion, which is spread over the fourth layer of muscles, confining the erector spinæ in the hollow by the side of the spinous processes. Inferiorly it is thickened by the tendons of the latissimus and lower serratus, but above it is continued beneath the splenius, without joining the upper serratus, and blends with the deep fascia of the neck. It is attached internally to the spinous processes; externally to the posterior third of the iliac crest, blending with the tendon of the latissimus, to the fascia lumborum, and to the ribs and a thin fascia over the intercostal muscles. Below, between the pelvic and spinous attachments, it blends with the underlying tendon of the erector spinæ and multifidus.

Vertebral aponeurosis.

Attachments.

* *Dissection.*—The superior serratus is to be cut through, and the subjacent vertebral aponeurosis taken away, and then the splenius muscle will be denuded.

Dissection.

The SPLENIUS muscle consists of cervical and cranial parts, which are named respectively splenius colli and splenius capitis. The two are united at their origin.

Splenius has two parts.

The *splenius colli* arises from the spines of the three or four upper dorsal vertebræ above the sixth. Ascending in the neck, the muscle is *inserted* by tendinous processes into the tips of the transverse processes (diapophyses) of the three upper cervical vertebræ, behind the attachment of the elevator of the angle of the scapula.

One to the neck.

The *splenius capitis* arises from the spines of the last cervical and first two dorsal vertebræ, and from the ligamentum nuchæ as high as the third cervical vertebra. The

One to the head.

fleshy fibres ascend and are inserted by a thin tendon into the apex and outer surface of the mastoid process, and into the bone behind it for about an inch and a half.

Their connections with other muscles.

The splenius colli is smaller than the splenius capitis, and its fibres are more oblique. These muscles are beneath the trapezius, the rhomboidei, and the serratus superior; and the insertion into the occipital bone is beneath the sterno-mastoideus. The complexus muscle can be seen above the upper border of the splenius capitis.

Dissection of fourth layer.

* *Dissection.* — To lay bare the fourth layer of muscles, the splenii must be detached from the spinous processes, and thrown outwards. The serratus inferior is also to be detached in the same way with the vertebral aponeurosis, and the connective tissue is to be cleaned from the surface of the large mass of the erector spinæ, that now comes into view.

Sacro-lumbalis and accessory muscles.

* Opposite the last rib is the beginning of an intermuscular interval, which divides the erector spinæ into an outer piece or the sacro-lumbalis, and an inner piece or the longissimus dorsi. By sinking the knife into this interval the sacro-lumbalis may be turned outwards, so as to uncover the fleshy slips of its accessory muscle, which are fixed to the angles of the ribs.

Offset to the neck.

A thin narrow muscle, the cervicalis ascendens, which is continued from the sacro-lumbalis beyond the ribs, should be separated in the neck from the muscles around by the dissector of that part.

Vessels and nerves.

* In preparing the sacro-lumbalis muscle, the external branches of the dorsal nerves with their accompanying arteries will be found.

Longissimus dorsi and prolongations.

* Before the longissimus can be displayed, it will be needful to raise towards the spinous processes the thin muscular fasciculus of the spinalis dorsi, which lies between that muscle and the spines of the vertebræ in the dorsal region. Then the attachments of the longissimus dorsi are to be traced out. Externally it has thin muscular processes of insertion into about the eight lower ribs. Internally it is inserted into the transverse processes of the lumbar and dorsal vertebræ by rounded tendons; and for the purpose of seeing these tendons, the longissimus must be drawn away from the spinous processes, and its superficial aponeurosis must be cut through below the ribs, in the line of

Vessels and nerves.

separation between this muscle and the multifidus spinæ on its inner side. Between the longissimus and the multifidus spinæ are the internal branches of the dorsal and lumbar nerves, and those of the intercostal and lumbar arteries.

Offsets to the neck.

The dissector of the neck should trace upwards a fleshy prolongation of the longissimus beyond the ribs: this is blended at first with the fibres of the longissimus ; but it is afterwards divided like the splenius into a cranial part (trachelo-mastoid) and a cervical part (transversalis colli).

Fourth layer of muscles consists of

* FOURTH LAYER.—In this layer are included the spinalis dorsi; the erector spinæ, with its divisions and its accessory muscles to the neck; and the complexus muscle. Most of the vessels and nerves of the back are in connection with this layer of muscles.

Spinalis dorsi, only along the dorsal vertebræ.

* The SPINALIS DORSI is found only by the sides of the spines of the dorsal vertebræ, and is united with the longissimus dorsi. Inferiorly it *arises* by tendinous processes from the spines of the last two dorsal and the first two lumbar vertebræ, and from the contiguous tendon of the longissimus. From this origin the fibres ascend forming arches, whose concavity looks inwards, and are connected by tendinous processes to the spines of the dorsal vertebræ, as low as the eighth or ninth, or only for half that extent.

Erector spinæ is single at its origin.

Attachments.

Divides at the last rib into two.

* The ERECTOR SPINÆ is the muscular mass on the side of the spine in the lumbar region. It is single and pointed below; and its cutaneous surface is covered near the sacrum by a wide and strong tendon, which is common to it and the multifidus spinæ. The muscle *arises* below from about the posterior fifth of the crest of the innominate bone, at the inner aspect, and many fibres take origin from the superficial tendon : in the lumbar region the fibres are also connected deeply by fleshy and tendinous processes to the whole length of each transverse process, to the tubercle (process. accessorius) at the root of the same, and to the layer of the fascia lumborum external to those processes. Opposite the last rib it divides into sacro-lumbalis and longissimus dorsi. The attachment on the inner aspect of the innominate bone corresponds in greater part to the origin of the gluteus maximus on the outer side.

Sacro-lumbalis

* The SACRO-LUMBALIS OR ILIO-COSTALIS is the smallest of the two pieces resulting from the division of the erector

spinæ. The fibres that compose it end in six or seven flat tendons, which are connected together by their margins, and are inserted into the angles of as many of the lower ribs. The muscle is continued onwards to the other ribs and the neck by a fleshy part, which constitutes the two undermentioned muscles: —

is inserted into six lower ribs.

Musculus accessorius

* The *musculus accessorius ad sacro-lumbalem* begins by a series of tendinous and fleshy bundles on the angles of the lower six ribs, internal to the tendons of insertion of the outer part or ilio-costalis; and ends in tendons, which are *inserted* into the remaining ribs (upper six) in a line with those of the ilio-costalis, and into the transverse process (diapophysis) of the seventh cervical vertebra.

is attached to the ribs.

Cervicalis ascendens

reaches the neck.

* The *cervicalis ascendens* is a muscular slip that prolongs the accessorius into the neck. United with the preceding, this muscle is attached to four ribs (third, fourth, fifth, and sixth), and is inserted into the tips of the transverse processes (diapophyses) of three cervical vertebræ, viz. sixth, fifth, fourth.

Longissimus dorsi

is inserted into ribs and transverse processes;

is continued to the neck by the

* The LONGISSIMUS DORSI gradually decreases in size as it ascends along the thorax, and is continued like the former to the neck. Internally the muscle is *inserted* into the tips of the transverse processes of all the dorsal vertebræ by a series of tendinous and fleshy bundles; and externally into the ribs, except the two or three first, by thin fleshy processes which are fixed between the tubercle and angle. Its muscular prolongation to the neck is inseparably united with the upper fleshy fibres, and splits into the two following pieces: —

transversalis colli,

The *transversalis colli* arises from the transverse processes of the upper six dorsal vertebræ, and is *inserted* into the transverse processes (diapophyses) of the cervical vertebræ, except the first and last.

and to the head by the trachelo-mastoid.

The *trachelo-mastoid* muscle arises in common with the preceding, and has besides an attachment by distinct tendons to the articular processes of the last three or four cervical vertebræ. The fibres form a thin muscle, that is *inserted* beneath the splenius into the upper half of the posterior part of the mastoid process: its insertion is about three quarters of an inch wide.

Connections of

* *Connections of erector spinæ.*—The erector spinæ and its

prolongations occupy the lumbar, thoracic, and cervical parts of the back. In the loins the muscle is contained in an aponeurotic sheath (p. 409.), and has the multifidus spinæ on its inner side: the attachments of the superficial tendon, which is common to it and the multifidus, will be described with the last mentioned muscle (p. 426.). Opposite the ribs the ilio-costalis and longissimus dorsi are concealed by the muscles of the other layers already examined. In the neck its accessory small muscles are beneath the splenius and the trapezius: the cervicalis ascendens is attached in a line with the splenius colli; and the transversalis colli and the trachelo-mastoid are more internal, or between these and the complexus. the erector spinæ.

The COMPLEXUS is internal to the prolongations from the longissimus dorsi, and converges towards its fellow of the opposite side at the occipital bone. Narrow at its lower end, the muscle *arises* by tendinous points from the tips of the transverse processes of the upper six dorsal and last cervical vertebræ, and from the articular processes of the other cervical vertebræ as high as the third: to the inner side of the muscle is frequently added a fleshy slip from the spines of one or two of the lower cervical vertebræ. From the tendons of origin the fibres pass upwards, the inferior more vertically than the superior, to be *inserted* into an impression between the curved lines of the occipital bone, which reaches outwards nearly two inches from the middle line. Complexus. Origin. Insertion.

The *biventer cervicis* is but a part of the preceding, internal to which it lies. It is usually described as a separate muscle, and has been named from its having two fleshy bellies with an intervening tendon. Its accessory piece.

The conjoined complexus and biventer cervicis muscles are concealed by the splenius and the trapezius; and on the cutaneous surface is a tendinous cross intersection towards the upper end. Two or three of the cervical nerves perforate the complexus. Along the inner side is the semispinalis muscle, with the ligamentum nuchæ. Beneath it are the small recti and obliqui muscles, the semispinalis, and the cervical nerves and vessels. Connections.

Dissection. — In the neck the nerves and vessels will be brought into view by detaching the complexus from the Dissection of the

nerves of the neck occipital bone and the spines of the vertebræ, and raising it with care from the subjacent parts. Beneath the muscle is a dense fascia, in which are contained the ramifications of the internal branches of the four or five highest cervical nerves. The first or suboccipital nerve is the most difficult of the set to find, but all should be sought with some care: this little nerve is a short trunk, which is contained in the interval between the recti and obliqui muscles near the head, and does not branch into two (inner and outer pieces) in the same regular way as the others; it will be best found by looking for the small twigs that are furnished by it to the recti muscles. The inner branches of the others are partly above and partly beneath the fibres of the semispinalis muscle. The external branches are very small, and are given off close to where the trunks appear.

and the vessels: In the dissection of those nerves the deep cervical artery is met with on the semispinalis muscle; a part of the vertebral artery will be found with the suboccipital nerve; and the occipital artery will be seen crossing the occipital bone.

of the same in the dorsal region: * Opposite the thorax the dorsal nerves and vessels will be readily dissected on the removal of a little fatty tissue from between the transverse processes, and on the inner side of the longissimus dorsi muscle. External and internal branches are to be traced from each trunk; some of the former have been seen in the interval between the sacro-lumbalis and longissimus dorsi.

in the lumbar region. * The lumbar nerves and vessels resemble the dorsal, and are found in the same line; but the inner branches are more difficult to recognise.

* The sacral nerves are beneath the multifidus spinæ, and will be dissected after the examination of that muscle (p. 426.)

Posterior division of spinal nerves. * Posterior Branches of the Spinal Nerves. — The spinal nerves, with a few exceptions in the cervical and sacral parts of the spinal column, bifurcate in the intervertebral foramina into anterior and posterior primary branches. The posterior, resulting from this division, turn backwards to supply the integument and the muscles of the back, and are now to be described.

In the neck *In the neck.*—The posterior primary branches of the cervical nerves are eight in number. All, except those of the

first two, appear beneath the posterior intertransverse muscles, and subdivide into an internal and an external branch. In both the first and second nerves, the posterior primary branch crosses the arch of the vertebra next beneath, after leaving its trunk. they divide into two.

a. The *external branches* are very inconsiderable in size, and end in the muscles inserted into the transverse processes, viz. the splenius, and the prolongations from the erector spinæ muscle. There is not any external branch to the first, or the suboccipital nerve. External branches are small. None to the first.

b. The *internal branches* are larger than the external. All are directed inwards beneath the complexus towards the spinous processes; and those of the lowest three nerves pass in addition beneath the semispinalis muscle. By the side of the spines of the vertebræ, cutaneous branches are furnished to the neck and the head, but only by those nerves that are superficial to the semispinalis; these superficial offsets ascend to the surface through the splenius, the complexus, and the trapezius muscles, and are distributed as before seen (p. 405.). In their course to the spine the nerves supply the surrounding muscles, viz. the complexus, semispinalis, multifidus spinæ, and interspinales. The inner branches of the second and third nerves end on the occiput, and require a separate notice. Internal branches above three last, give cutaneous offsets. Those of second and third.

That of the second nerve, named *great occipital*, appears beneath the inferior oblique muscle to which it gives offsets: it is then directed upwards to the head through the complexus and the trapezius, and ends on the occiput (p. 9.). Second ends on head.

The branch of the third nerve supplies an offset to the integument of the neck; and then ascending to the head through the trapezius, is distributed to the lower part of the occiput, internal to the great occipital nerve. Usually this nerve joins the preceding both beneath, and superficial to the trapezius. Third supplies neck and head.

The posterior primary branch of the suboccipital or first spinal nerve, deviates from the others in its course and branching. It is very short, and appears in the interval between the recti and obliqui muscles; in passing from the spinal canal it is placed between the arch of the atlas and the vertebral artery, and pierces the ligament between the first cervical vertebra and the occipital bone. The follow- Suboccipital nerve has different branching; ends in

the muscles. ing branches radiate from the extremity of the nerve: — One enters the under surface of the complexus near the cranial attachment. A slender branch is furnished to each of the small muscles that bound the space in which the nerve is contained, viz. the rectus major and minor, and the superior and inferior oblique: the offset to the last muscle often joins the inner branch of the second cervical nerve. Occasionally a cutaneous offset. Occasionally this nerve gives a cutaneous branch to the occiput.†

Posterior cervical plexus. The suboccipital nerve and the internal branches of the next two cervical nerves are sometimes connected by offsets beneath the complexus; when such an intercommunication exists, it forms the "posterior cervical plexus" of M. Cruveilhier.

Twelve dorsal nerves divide into inner and outer branches. * In the *dorsal region.*—The posterior primary branches of the dorsal nerves are twelve in number, and appear between the transverse processes. Each nerve soon divides into an internal and an external branch, which are distributed after the same plan as those in the neck. Cutaneous offsets are furnished from the one or the other set of branches, but not commonly from both branches of the same nerve.

Outer branches of upper six end in muscles, * *a.* The *external branches* increase in size from the first to the last, and are differently distributed above and below. The *upper six* or eight pass beneath the longissimus and its cervical prolongation, as far as to the interval between the longissimus and the ilio-costalis, and end by supplying these but those of lower six give cutaneous offsets. muscles and the levatores costarum. The *lower six* or four have a similar arrangement and distribution with respect to the muscles; but, after reaching the interval between the ilio-costalis and the longissimus dorsi, they are continued to the surface through the serratus and latissimus muscles, in a line with the angles of the ribs.

Inner branches of upper six have cutaneous offsets. * *b.* The *internal branches* decrease in size from above downwards. The *upper six* are directed inwards between the semispinalis dorsi and multifidus spinæ muscles, and become cutaneous along the side of the spinous processes, by perforating the rhomboideus and trapezius muscles. Offsets are supplied to the muscles between which they are placed. Lower six not. The *lower six* are small in size, and end in the multifidus spinæ muscle.

Lumbar nerves * *In the loins.* — The posterior primary branches of the

† See note to p. 139. of the first edition of this work.

lumbar nerves are five in number, and appear between the erector and multifidus spinæ. In their mode of dividing and general arrangement they resemble the dorsal nerves. Cutaneous offsets are furnished only by the external set of branches. are divided into two.

* *a.* The *external branches* enter the fibres of the erector spinæ, and supply it and the small intertransverse muscles. The first three pierce the erector spinæ, and become cutaneous after perforating the aponeurosis of the latissimus. The outer branch of the last nerve is connected with the corresponding part of the first sacral nerve by an offset which lies near the bones. External branches give cutaneous from first three.

* *b.* The *internal branches* are supplied to the multifidus spinæ muscle. Near their origin they are difficult to find, in consequence of being contained in grooves close to the articular processes of the vertebræ. Internal branches end in the muscles.

* VESSELS IN THE BACK.—The vessels that are now dissected are the occipital and the deep cervical artery; part of the vertebral artery; and the posterior branches of the intercostal and lumbar arteries of the aorta. Veins accompany the arteries for the most part. The vessels are

In the neck. — The vessels in the neck are the occipital, the vertebral, and the deep cervical.

The *occipital artery* may be seen coursing along the occipital bone. Appearing from beneath the digastric muscle, the vessel is directed backwards beneath the sterno-mastoideus, the splenius, and sometimes the trachelo-mastoideus, but over the obliquus superior and complexus muscles. Near the middle line of the body it perforates the trapezius and ascends to the occiput, on which it is distributed (p. 6.). It supplies the surrounding muscles, and furnishes the following branch to the neck: — Part of the occipital artery, which gives a

The *cervical branch* (r. princeps cervicalis) distributes twigs to the under part of the trapezius, and then passing beneath the complexus, anastomoses with the vertebral and deep cervical arteries. cervical branch.

The *vertebral artery* lies on the posterior arch of the first vertebra, behind the articulating process of that bone; and appears in the interval between the straight and oblique muscles, as it passes beneath the ligament between the atlas and the occipital bone on its way to the skull. Small Part of the vertebral artery.

branches are supplied by the vessel to the surrounding parts. Beneath the artery is the suboccipital nerve.

Deep cervical artery. The *deep cervical artery* is a branch of the superior intercostal (of the subclavian, p. 75.), and resembles the posterior branches of the other intercostal arteries. Passing backwards between the transverse process of the last cervical vertebra, and the neck of the first rib, the vessel appears in this dissection between the complexus and semispinalis muscles. Finally, the artery ascends as high as the upper border of the semispinalis muscle, and anastomoses with the cervical branch of the occipital artery. The contiguous muscles receive branches from the deep cervical artery, and anastomoses are formed between its offsets and those of the vertebral artery.

Intercostal arteries are split into * *In the dorsal region.* — The posterior branches of the intercostal vessels accompany the nerves between the vertebræ and the anterior costo-transverse ligaments. In the back they are divided like the nerves into inner and outer branches.

inner and * *a.* The *inner branches* end in the fleshy mass of the multifidus spinæ and semispinalis muscles, and furnish small offsets with those nerves which reach the surface.

outer branches, * *b.* The *external branches* cross beneath the longissimus dorsi, and supply it and the erector spinæ. Like the nerves, the lowest branches of this set are the largest, because they extend to the surface.

and give a branch to spinal cord. As the dorsal branch of the intercostal artery passes by the intervertebral foramen, it furnishes a small *intraspinal artery* to the cord and its membranes, as well as other twigs to the vertebræ.

Lumbar arteries * *In the loins.* — The posterior branches of the lumbar arteries divide, like the intercostal, into internal and external pieces, as soon as they reach the interval between the longissimus dorsi and multifidus spinæ. They give also a *spinal branch* to the spinal canal, and the cord with the investing membranes.

are also divided into

inner and * *a.* The *internal branches* are small, and end in the multifidus spinæ muscle.

outer branches. * *b.* The *external branches* supply the erector spinæ, and some are continued onwards, with the nerves, to the integuments.

Veins VEINS. — With the deep cervical artery is a large vein,

vena profunda cervicis, that communicates with the occipital and other deep veins in this region, forming the posterior plexus of the neck; and then passes forwards between the transverse processes, with its companion artery, to join the vertebral vein. The *occipital vein* lies with its artery, and sometimes communicates with the lateral sinus through the mastoid foramen. The *dorsal* and *lumbar* veins correspond in their branching and distribution to the arteries they accompany, and end in the intercostal veins. In contact with the spinous processes and plates of the vertebræ is a deeper set of veins (*dorsi spinal*), which anastomose freely together, and enter the veins in the interior of the spinal canal.

are deep cervical,

occipital,

dorsal and lumbar,

and deep veins.

* *Dissection.*—Most of the remaining fifth layer of muscles of the back is uncovered by the previous dissection. Thus, between the first two vertebræ and the occipital bone lie the small straight and oblique muscles: in the cervical and dorsal regions the semispinalis muscle will be seen, with the small interspinal muscles internal to it; and occupying a corresponding position in the loins is the multifidus spinæ. The small intertransverse muscles in the lumbar region will be found by cutting through the erector spinæ.

Dissection of the last layer of muscles.

* FIFTH LAYER.—In this layer are the following small muscles;—the recti and obliqui, the semispinales, interspinales, multifidus spinæ, and intertransversales.

Muscles of the fifth layer.

The RECTUS CAPITIS POSTICUS MAJOR is the largest of the three muscles between the occipital bone and the first two vertebræ. It *arises* from the side of the spine of the second vertebra, and is *inserted* into the outer part of the inferior curved line of the occipital bone for about an inch, as well as into the surface below it: its upper attachment is beneath the superior oblique muscle. This muscle is directed outwards very obliquely, and forms one side of the triangular space which contains the suboccipital nerve.

Rectus capitis major; between axis and occipital bone.

The RECTUS CAPITIS POSTICUS MINOR is internal to the preceding, and is much smaller than it. *Arising* from the neural arch of the atlas, the muscle ascends to be *inserted*, close to the middle line, into the inferior curved ridge of the occipital bone, and between this and the foramen magnum. This small muscle is fan-shaped, and is deeper than the rectus major: it covers the ligament between the atlas and

Rectus capitis minor passes from atlas to occipital bone.

the occipital bone. The two small recti muscles correspond to the interspinales between the other vertebræ.

Obliquus inferior, to first two vertebræ.

The OBLIQUUS INFERIOR lies obliquely between the first two vertebræ. It *arises* from the spinous process of the axis, external to the rectus major muscle, and is *inserted* into the transverse process (diapophysis) of the atlas.

Obliquus superior extends from atlas to occiput.

The OBLIQUUS SUPERIOR takes *origin* from the upper part of the transverse process of the atlas, where the preceding muscle terminates, and is directed inwards to be *inserted* between the curved lines of the occipital bone, near the mastoid process. This muscle is concealed by the complexus and trachelo-mastoideus, and crosses the vertebral artery.

Connections.

Its insertion is beneath the splenius, but above the rectus major muscle.

Semispinalis is divided into

The SEMISPINALIS occupies the vertebral groove in the dorsal and cervical regions, and extends from the transverse and articular processes to the spines of the vertebræ. The lower part of the muscle is called semispinalis dorsi, and the upper part semispinalis colli.

semispinalis dorsi, and

The *semispinalis dorsi* arises from the transverse processes of the dorsal vertebræ, from the tenth to the sixth; and is *inserted* into the spinous processes of the upper four dorsal and the last two cervical vertebræ.

semispinalis colli.

The *semispinalis colli* arises from the transverse processes of the upper five or six dorsal vertebræ, and from the articular processes of the cervical vertebræ, except the first three: it is inserted into the spines of the cervical vertebræ above the attachment of the semispinalis dorsi, the atlas not receiving any slip.

Connections.

The semispinalis muscle is covered by the complexus, and by the deep cervical artery and the cervical nerves. To its inner side is the multifidus spinæ muscle.

Interspinal muscles in pairs

* The INTERSPINAL MUSCLES are placed as their name expresses: they are arranged in pairs, a muscle being on each side of the interspinous ligament, and are best seen in the neck and loins.

in the neck;

In the *cervical region* the muscles are situate between the spinous processes, but they are absent from the interval between those of the first two vertebræ. They are small round bundles, and are attached above and below to the bifurcated apices of the spines.

in the back;

* In the *dorsal region* the muscles are rudimentary, and exist only between the first, or the first two pairs of the vertebræ; and between the pair above the lowest dorsal, as well as between this and the first lumbar vertebra.

* In the *lumbar region*, as in the cervical, there is a pair in each interspinous space. Here they are thin flat muscles, which reach all the length of the spines. In the loins.

* The INTERTRANSVERSE MUSCLES lie between the transverse processes of the vertebræ; but only those in the loins and the back are now dissected. Inter-transverse muscles

In *the neck* they are double, like the interspinal muscles of the same vertebræ (p. 179.). in the neck,

* In the *dorsal region* they are single rounded bundles, and are found only between the lower processes: their number varies from three to six. Between the upper processes tendinous bands take their place. in dorsal region,

* In the *lumbar region* the anterior set form four thin and fleshy muscular planes between the bony processes. The posterior set are rounded fasciculi, which are attached to the accessory processes at the roots of the transverse: they have been named *interaccessorii*. in loins.

* *Dissection.*—The multifidus spinæ muscle, which fills the hollow by the side of the spinous processes, may be now dissected. Over the sacrum it will be necessary to remove from it, after examination, the thick aponeurosis that covers it and the erector spinæ. In the neck, and in the dorsal region the muscle will appear on detaching the semispinalis from the spines, and turning it aside. Dissection of multifidus spinæ.

* The MULTIFIDUS SPINÆ muscle extends from the sacrum to the second vertebra, and is much larger towards the pelvis than in the neck. It takes its *origin* inferiorly from the aponeurosis covering the surface; from the back of the sacrum between the central and external row of processes, as low as the fourth aperture; from the inner surface of the posterior superior iliac spine of the innominate bone, and from the ligaments connecting this bone to the sacrum. Along the side of the spine, the muscle arises differently in the several regions: — Thus in the loins it arises by large fasciculi from the accessory and the articular processes of the lumbar vertebræ; in the dorsal region, from the transverse processes of the corresponding vertebræ; and in the Multifidus spinæ has an extensive origin.

neck, from the articular processes of the four or five lower cervical vertebræ. From this origin the fibres are directed obliquely inwards, some extending more than the length of one vertebra, to be *inserted* into the spines and the laminæ of all the vertebræ between the first cervical and last sacral.

Insertion.

Connections. This muscle fills chiefly the vertebral groove, and is concealed by the erector spinæ and the semispinalis. The internal branches of the vessels and nerves of the back lie along its outer border. The following small muscles may be said to be parts of the multifidus.

Rotatores spinæ are parts of multifidus. * *Rotatores spinæ.*—These are eleven small muscles beneath the multifidus spinæ in the dorsal region, and are separated from that muscle by connective tissue. Each is attached on the one hand to the tip and the upper edge of a transverse process, and on the other to the lower border of the lamina of the vertebra next above. The first springs from the transverse process of the second vertebra.

Aponeurosis of multifidus. * The *aponeurosis* common to the multifidus and erector spinæ is fixed firmly to the surrounding bones, and furnishes attachment to the muscular fibres. In the middle line it is connected with the spines of the lower lumbar vertebræ, and with those of the sacrum. On the outer side it is attached to the posterior part of the iliac crest, and to the outer row of tubercles on the back of the sacrum, being at the last spot connected with the great sacro-sciatic ligament. Above, it is continued some way on the surface of the erector spinæ, but further on the longissimus dorsi than on the ilio-costal portion. Blending with the cutaneous surface below is the vertebral aponeurosis (p. 413.).

Dissection of sacral nerves. * *Dissection.*—To find the branches of the sacral nerves, it will be necessary to remove the part of the multifidus spinæ which covers the sacrum. These nerves are very fine, but they may be detected by following inwards the external branches that lie on the great sacro-sciatic ligament. The lowest two nerves must be sought on the back of the sacrum, below the extent of the multifidus spinæ muscle: the fourth comes through its aperture, and the fifth between the sacrum and coccyx.

Five sacral nerves: SACRAL NERVES.—The posterior primary branches of the sacral nerves are five in number: four issue from the spinal canal by the apertures in the back of the sacrum, and the

fifth between the sacrum and the coccyx. The first three have the common division into inner and outer branches, like the other spinal nerves, but the last two are undivided.† are differently distributed.

* The *first three nerves* are covered by the multifidus spinæ, and divide regularly. The *inner branches* of these nerves end in the multifidus. The *outer branches* are larger in size, and have communicating offsets from one to another on the back of the sacrum: the outer branch of the first nerve is further connected with the corresponding part of the last lumbar; and that of the third nerve joins in a similar manner the sacral nerve next below. After this looping, the nerves pass outwards to the surface of the great sacro-sciatic ligament, where they join a second time, and then become cutaneous.—(See DISSECTION OF THE BUTTOCK.) First three have inner and outer branches; the last give cutaneous offsets.

* *Last two nerves.*— These nerves, which are below the multifidus, are much smaller than the preceding, and want the regular branching of the others: they are connected one with another, and with the coccygeal nerve, on the back of the sacrum. A few filaments are distributed to the back of the sacrum and the coccyx. Last two are undivided.

* The *coccygeal nerve* issues through the lower aperture of the spinal canal, and may be recognised with care by the side of the coccyx. It is joined by the last sacral nerve, and ends on the posterior aspect of the coccyx. Coccygeal nerve.

* Small *sacral arteries* leave the spinal canal with the sacral nerves; they supply the muscular mass of the erector spinæ, and the structures on the back of the sacrum. Anastomoses take place between these vessels and the branches on the sacrum from the gluteal and sciatic arteries. Small sacral arteries.

* *Dissection.*— The examination of the posterior part of the wall of the thorax may be made before the body is again turned. By the removal of the ilio-costalis and longissimus dorsi, opposite the ribs, the small levatores costarum will be uncovered. The hinder part of the external intercostal muscle will be denuded at the same time. Dissection of intercostal structures.

* The LEVATORES COSTARUM are twelve small fan-shaped Levatores

† See a paper on the mode of branching of the spinal nerves, in the *Lond. Med. Gazette* of Feb. 10., 1843.

costarum extend from transverse processes to ribs. muscles, which are connected with the hinder part of the ribs. Each, except the first, *arises* from the apex and lower border of the transverse process of a dorsal vertebra, and is *inserted*, the fibres spreading out, into the upper border of the rib beneath, from the tubercle to the angle. The muscles increase in size from above down, and their fibres have the same direction as the external intercostal layer. The first is fixed above to the transverse process of the last cervical vertebra, and below to the outer surface of the first rib.

Other elevator muscles. In some of the four lower muscles a few fibres are continued beyond one rib to that next succeeding. These longer slips have been named *levatores longiores costarum.*

Outer intercostal muscle. * The *external intercostal muscle* is continued backwards along the ribs as far as the tubercle, and is overlaid by the elevator muscle. Beneath this outer muscle are the intercostal nerve and artery.

Dissection. * *Dissection.*— To trace the anterior and posterior primary branches of the dorsal nerves to their origin in a common trunk, the elevator of the rib and the external intercostal muscle are to be cut through in one or more spaces. The intercostal artery, with its posterior branch, is laid bare at the same time.

Dorsal nerve has * The *dorsal nerves* can be now seen to split in the intervertebral foramina into anterior and posterior primary branches.

posterior * The *posterior* branches are directed backwards, internal to the anterior costo-transverse ligament, and have been already examined (p. 420.).

and anterior trunk. * The *anterior* is named intercostal, and is continued between the ribs, to the front of the chest. Its anatomy is learnt in the dissection of the thorax (p. 267.).

Intercostal artery. * The *intercostal artery* has an almost exact correspondence with the dorsal nerve in its branching and distribution.

CHAPTER VI.

DISSECTION OF THE SPINAL CORD AND ITS MEMBRANES.

THE spinal cord gives origin to the spinal nerves, and is lodged in the canal formed by the bodies and the arches of the vertebræ. It is invested by prolongations of the membranes of the brain, which form sheaths around it, and is supported by them in its large canal.

Cord is contained in spinal canal, invested by membranes.

Dissection.—To obtain the cord and its enveloping membranes, it will be necessary to open the spinal canal; but as a preparatory step all the muscle is to be taken from the arches and spines of the vertebræ. The canal may be opened by sawing through the neural arches, on each side, close to the articular processes; and the cuts of the saw should extend to the lower end of the sacrum, but not higher in the neck than the fourth cervical vertebra. As it is difficult to use the saw in the hollow of the lumbar region, a chisel and a mallet will be found useful to divide the arches of the vertebræ. When the loose bits of bone have been taken away, the tube of the dura mater will be seen to be covered by some veins and fat, and by a loose connective tissue sometimes containing fluid, especially at the lower part. The fat is to be scraped away with the handle of the scalpel, and the lateral prolongations through the intervertebral foramina are to be defined.

Dissection to get cord and membranes.

MEMBRANES OF THE CORD.—Three membranes, like those of the brain, envelop the cord, viz. an external tube of dura mater, an internal sheath of pia mater, and an intervening arachnoid or serous covering.

Three membranes of the cord.

The *dura mater* forms a strong tube, and is prolonged from that lining the interior of the skull. Surrounding loosely the cord and the nerves, it extends along the spinal canal, and forms a sheath as far as the top of the sacrum; but beyond that point it is impervious, and is continued by a slender cord to the back of the coccyx. The capacity of

Dura mater surrounds cord loosely,

the sheath is much greater than is necessary for the contents; and the size of the sheath is also larger in the neck and the loins than in the back. On the outer aspect the dura mater is smooth, when a comparison is made between it and that in the skull, for it does not act as a periosteum to the bones. Between it and the osseous surfaces are some vessels and fat; and it is connected to the posterior common ligament of the vertebræ by a few fibrous bands. On each side the dura mater sends offsets along the spinal nerves issuing by the intervertebral foramina; inferiorly these several offsets become gradually longer, forming small tubes which enclose the sacral nerves, and lie for some distance within the spinal canal. In the midst of these tubes, into which the dura mater seems to be divided below, will be seen the slender before-mentioned impervious cord, that descends from the lower part of the tube of the dura mater to the end of the spinal canal, and blends with the periosteum covering the back of the coccyx.

and is slightly connected with bones around.

It gives offsets on spinal nerves

and one central inferior piece.

Dissection to remove cord

Dissection.—The sheath of the dura mater with the contained cord is next to be removed from the body. For this purpose the lateral processes in the intervertebral apertures are to be cut, and the central prolongation is to be detached from the coccyx. Next, the cord and its membranes are to be divided opposite the lower cervical vertebræ, and to be removed by cutting the bands that attach the dura mater to the ligament of the vertebræ.

and see next covering.

When the cord is taken out, it is to be placed on a piece of board, or on a table, with the lateral offsets widely separated. To show the arachnoid covering, the dura mater is to be slit along the middle, on one or both aspects, as far as the small median cord before referred to; but the membrane is to be raised whilst it is being cut through, so that the loose arachnoid, that envelops the cord, may not be injured. Lastly, the dura mater is to be fastened back with pins.

Arachnoid membrane has a

The *arachnoid membrane* is the thin serous covering of the cord which is immediately beneath the dura mater. Like the corresponding membrane in the skull, it invests the nervous centre and lines the dura mater, and consists thus of a visceral and a parietal part *; but the visceral piece,

* This reflection of the membrane over the dura mater is denied by

around the cord, is much looser than the like part on the brain. The outer or *parietal* part is inseparably joined to the inner surface of the dura mater, and gives to that membrane its shining appearance. The inner or *visceral* layer surrounds the cord loosely, so as to leave a considerable interval between the two (subarachnoid space): at the lower part of the spinal canal this loose sheath is much the largest, and envelops the mass of nerves that form the cauda equina. As the different spinal nerves extend to the intervertebral foramina they receive sheaths from the loose or visceral part of the arachnoid membrane, and retain the same till they perforate the dura mater.

Parietal or attached layer, and a loose or visceral layer. Subarachnoid space.

Dissection.—The subarachnoid space of the cord may be made evident, either by placing the handle of the scalpel beneath the visceral layer, or by putting a detached piece of the cord in water, with the posterior aspect uppermost, and blowing air beneath the serous membrane.

To expose subarachnoid space.

The *subarachnoid space* is situate between the loose or visceral part of the arachnoid membrane, and the spinal cord invested by pia mater. Larger at the lower than at the upper part of the spinal canal, the space contains a special fluid (cerebro-spinal); and it communicates with the cavity in the interior of the brain by the aperture in the fourth ventricle. Crossing the space at the posterior part of the cord, are bundles of fibrous tissue, especially in the neck, where these bands are collected into an imperfect partition or septum along the middle line. In the space likewise are the serrations of the ligamentum denticulatum, and the roots of the spinal nerves, with some vessels.

Subarachnoid space contains a fluid, and opens into cavities of brain.

There is an imperfect septum behind.

Dissection.—For the purpose of seeing the next covering of the cord with the ligamentum denticulatum, the arachnoid membrane is to be taken away.

Dissection of next covering.

The *pia mater* is much less of a vascular structure on the spinal cord than on the brain. Thicker and more fibrous in its nature, the membrane closely surrounds the cord; it sends thin prolongations into the anterior and posterior median fissures of the cord, and furnishes offsets to the roots of the spinal nerves. The outer surface of the pia mater is

Pia mater supports the cord, gives offsets.

Kölliker. According to the view of this anatomist, the membrane is a simple tube corresponding to the *visceral* layer in the text.

Fibrous bands are connected with it. rough. Along its front is a central, anterior fibrous band (linea splendens, Haller); and on each side another fibrous band, the ligamentum denticulatum, is attached to it. Scattered through the fibrous membrane are branched yellow or brown pigment cells, which in the neck are so numerous as to give it a darkish appearance.

And ends inferiorly in a fibrous piece, Where the medulla spinalis ceases, viz. about the lower part of the body of the first lumbar vertebra, the investing tube of the pia mater is suddenly reduced in size, and has the appearance of a round fibrous cord. This cord-like part reaches towards the end of the spinal canal: it is unprovided with nervous substance, except for a short distance, and is blended with a central impervious prolongation of the dura mater, on a level with the upper part of the sacrum. It serves to fix the lower end of the medulla, and has been named, from that circumstance, the *central ligament* of the cord. A vein and artery accompany this fibrous piece, and thus mark it out from the surrounding nerves. which is called central ligament.

The dentate ligament, which is fixed on one side to cord, The *ligamentum denticulatum* is the white fibrous band on each side of the spinal cord, that is so named from its serrated appearance: it has the same structure as the dura mater, except that it wants an epithelial covering. Situate between the anterior and posterior roots of the nerves, the band reaches upwards to the medulla oblongata, and ends inferiorly on the lower pointed extremity of the cord. Internally it is united to the pia mater. Externally it ends in a series of triangular or tooth-like projections, which are fixed at intervals along the dura mater, each being about midway between the apertures of transmission of the roots of the spinal nerves. There are twenty or twenty-one of these denticulations, of which the first is attached to the dura mater opposite the margin of the occipital foramen, between the vertebral artery and the hypoglossal nerve; and the last is inserted opposite the last dorsal or the first lumbar vertebra. This fibrous band supports the spinal cord, and has been called a ligament from that circumstance. and on other to dura mater by points. Number and attachment of these.

Vessels and nerves of dura mater, *Vessels and nerves of the membranes.*—The *dura mater* of the cord has but few vessels in comparison with that in the skull, for its office is different; nerves have not yet been traced into it, though they have been found on the vessels that supply the cord and its membranes.

The *arachnoid* is sparingly supplied with vessels like serous membranes in general, and proof of its containing nerves is yet wanting. of arachnoid;

The *pia mater* has a network of vessels in its substance, though these are much less marked than in the membrane on the brain, and from them offsets enter the cord. In its substance are many nerves; these were supposed by Purkinje to be derived from the sympathetic, but Remak has shown that their chief source is from the posterior roots of the spinal nerves. of pia mater.

Dissection.—The arachnoid membrane is next to be taken from the fibrils of the roots of a nerve; and the roots of the nerve are to be traced outwards to their transmission through two apertures in the dura mater. One or more of the lower offsets of the dura mater, that have been cut of some length, are to be laid open to show the contained ganglion. The student should define the ganglion, and should trace the roots of the nerve to their union beyond the ganglion. Dissection of roots of nerves.

Spinal Nerves. — The spinal nerves are thirty one in number. The trunks are constructed by the blending together of two roots (anterior and posterior) in the intervertebral foramina. They are divided into groups corresponding to the regional subdivisions of the spinal column, viz. cervical, dorsal, lumbar, sacral, and coccygeal. In each group the nerves are equal to the number of the vertebræ, except in the cervical region of the spine, where there are eight, and in the coccygeal region, where there is only one. In consequence of the cervical nerves exceeding the number of the vertebræ, the last is placed below the seventh vertebra; and thus the lowest nerve of each group will be below its corresponding vertebra. Each nerve divides into two, viz. anterior and posterior primary branches; the former of these is distributed to the front of the body and the limbs, and the latter is confined to the hinder part of the trunk. Trunks of spinal nerves. Number and arrangement in groups. Last nerve of a group below the vertebra.

Roots of the Nerves.—Two roots or bundles of fibrils (anterior and posterior) attach the nerve to the spinal cord; and these blend together to form the trunk of the nerve either in the intervertebral foramen, or, it may be, in the spinal canal. The posterior root is marked by a ganglion, but the anterior root is aganglionic. Each nerve has two roots, anterior and posterior.

The *posterior* or *ganglionic roots* surpass in size the an- Posterior root

is larger than anterior: terior, and are formed by larger and more numerous fibrils. They are attached to the side of the cord between the posterior and lateral columns or pieces, in a straight line, which

forms two bundles. they keep even to the last nerve. In their course to the trunk of the nerve, the fibrils of the root pass outwards, converging to an aperture in the dura mater opposite the intervertebral foramen; as they approach that aperture they are

that enter the ganglion. collected into two bundles which, lying side by side, receive a sheath from the dura mater, and enter the intervertebral ganglion.

Anterior root is without ganglion, The *anterior* or *aganglionic roots* arise from the side of the cord by filaments that are attached irregularly — not in a straight line, and approach inferiorly the centre of the front of the cord.

has a separate opening in dura mater, Taking the same direction as the posterior root to the intervertebral foramen, the fibrils enter a distinct opening in, and have a separate sheath of the dura mater: in their further course to the trunk of the nerve,

and joins posterior root beyond ganglion. they pass over the ganglion of the other root, without joining it, and finally the two roots are blended beyond the ganglion to form one trunk.

Characters of roots. *Characters of the roots.* — Besides the relative size between the two roots, the following characters are to be noted: —

Some set of fibrils join. *Union of the fibrils.* — The fibrils of the posterior root never join those of the anterior; and the opposite. But the anterior root of one nerve may receive offsets from the corresponding root of the nerve above, and the same may occur in the posterior roots.

Posterior root largest, *Relative size of the roots.* — The posterior root is larger than the anterior, except in the suboccipital nerve; and the number of the fibrils is also greater.

proportionally largest in neck. Further, the posterior is proportionally larger in the cervical than in any other set of the nerves; in the dorsal nerves there is but a very slight difference in favour of the hinder root.

Roots increase above down, *Size of the roots along the cord.* — Both roots are larger where the nerves for the limbs arise, than at other parts of the cord, and greater in the nerves to the lower than in those

except dorsal and sacral. to the upper limbs; so that the nerve roots increase in size from above down, except at the lower extremity of the cord, and in the dorsal region where they are of much the same size from the second to the last.

Direction and length. — As the apertures of transmission from the spinal canal are not opposite the place of origin of the nerves, the roots must be directed more or less obliquely. This obliquity increases from above down; for in the upper cervical nerves the roots are horizontal, but in the lumbar and sacral nerves they have a vertical direction around the end of the medulla spinalis. This appearance of the long fibrils around the end of the cord has much resemblance to the extremity of a horse's tail, and bears appropriately the term *cauda equina*.

Oblique in their course.

Most so inferiorly,

and form cauda equina.

The length of the roots increases proportionally as the obliquity, so that in the lower cervical nerves it amounts to the depth of one vertebra; in the lower dorsal it corresponds with the depth of two vertebræ; and in the lumbar and sacral nerves each succeeding root becomes a vertebra longer, since the cord does not reach beyond the first lumbar vertebra.

Length increases from above down.

Place of union of the roots. — Commonly the roots unite as before stated in the intervertebral foramina; and the trunk of the nerve bifurcates at the same spot into its anterior and posterior primary branches. But deviations from this arrangement are found at the upper and lower ends of the spinal column, in the following nerves: —

Union of the roots. In intervertebral foramen,

The roots of the first two cervical nerves join in each instance on the neural arch of the corresponding vertebra; and the anterior and posterior branches diverge from the trunk in that situation.

except in first two cervical,

In the sacral nerves the union of the roots takes place within the canal; and the primary branches of the nerves issue by the apertures in the front and back of the sacrum.

and the sacral

The roots of the coccygeal nerve are also united in the spinal canal; and the anterior and posterior branches of its trunk escape by the lower aperture of that canal.

and coccygeal nerves.

Ganglia and their situation. — Each posterior root is provided with a ganglion: but sometimes the first or suboccipital nerve is without a posterior root and a ganglion. The ganglia are reddish in colour, and appear oval in shape, whilst they are surrounded by the dura mater; and their size is proportioned to that of the root. By means of the dissection that has been made, the ganglion may be seen to be bifid at the inner part, where it is joined by the fibrils of

Number of ganglia

form

construction.

Two ganglia. the root; so that it might be said to possess two small ganglia, one for each bundle of fibrils, which are joined together at their outer ends.

Their usual situation. The ganglia are situate commonly in the intervertebral foramina, but where the regular position of those apertures is wanting, as at the upper and lower extremities of the spinal canal, they have the following position: — In the first two nerves they lie on the arches of the first and second vertebræ. In the sacral nerves they are contained in the spinal canal. In the coccygeal nerve the ganglion is also within the canal, and about the middle of the long posterior root (Schlemm).

Exceptions in neck. Sacral and coccygeal.

Arteries of cord are VESSELS OF THE SPINAL CORD. — The arteries on the surface of the cord are anterior and posterior spinal.

Anterior spinal, a single artery, and is continued by anastomotic branches. The *anterior spinal artery* occupies the middle line of the cord beneath the fibrous band before alluded to in that position. It commences at the medulla oblongata by the union of two small branches of the vertebral artery (p. 189.); and it is continued to the lower part of the cord by a series of anastomotic branches, which are derived from the vertebral and ascending cervical arteries in the neck, and from the intercostal and lumbar arteries in the back and loins. The branches of this artery ramify in the pia mater, and are then distributed to the substance of the cord, some entering the median fissures. Inferiorly it supplies the roots of the nerves forming the cauda equina, and ends on the central fibrous prolongation of the cord.

Termination.

Posterior arteries are two; lie on sides of cord; are continued along cord like anterior. The *posterior spinal arteries*, one on each side, are continued from the upper to the lower part of the cord, behind the roots of the nerves. Dividing into small branches, the vessels of opposite sides form a free anastomosis around the posterior roots, and some offsets enter the fissure of the cord. These vessels begin superiorly by offsets from the vertebral artery, and their continuity is maintained by a series of anastomotic branches, which enter the canal along the spinal nerves, and are furnished from the same source as the twigs that reinforce the anterior spinal artery.

Veins. The *veins* of the spinal cord are very tortuous, and form a plexus on the surface. At intervals, larger trunks arise, which accompany the spinal nerves to the intervertebral foramina, and end in the veins outside the spinal canal. Near the top of the cord the veins are united into two or more small branches; these terminate in the inferior cerebellar, or in the petrosal sinuses, after communicating with the vertebral veins.

Termination at top of cord.

Situa- The SPINAL CORD (medulla spinalis) is the cylindrical

elongated part of the cerebro-spinal centre that is enclosed within the spinal canal. Invested by the membranes before examined, the medulla occupies about two thirds of the length of the canal formed by the vertebræ, and is much smaller than the bony case that surrounds it. tion of the cord.

The extent of the cord is from the level of the atlas to the lower border of the first lumbar vertebra, but its termination inferiorly may be a little higher or lower than that spot. Its length is usually about sixteen or seventeen inches. Superiorly the cord joins the medulla oblongata; and inferiorly it becomes pointed, being sometimes marked by one or two swellings, and ends in the fibrous prolongation of the pia mater named the central ligament of the cord. In the embryo, before the third month, the medulla reaches all the length of the spinal canal, but it gradually recedes afterwards from below, as the surrounding bones increase in size, until it takes the position it has in the adult. Its extent varies below. Length. Inferior termination in the adult and in the embryo.

The size of the spinal cord is much increased opposite the origin of the nerves for the supply of the limbs. There are therefore two enlargements on it: — one corresponds to the lower cervical vertebræ, reaching as high as the third; the other is smaller, and is on a level with the last dorsal vertebra. In the cervical enlargement, the greatest thickness is from side to side; but in the inferior swelling the measurement of the cord is greatest from before back. Its size is increased where the nerves of the limbs are attached.

Whilst the pia mater remains on the cord, the anterior surface is distinguished from the posterior by the central fibrous band and the anterior spinal artery; and by the irregular line of the anterior roots, which approaches the centre towards the lower end. Anterior aspect distinguished from posterior.

Dissection. — For the examination of the structure the student should possess a piece of the cord which has been hardened in spirit, for that which is obtained from the spinal canal, at this period, is not fitted for the purpose of dissection. Supposing the pia mater removed from the surface of the cord, without the roots of the nerves being detached, the student will be able to observe the following divisions in it: — Dissection to see constituents of cord.

Fissures of the Cord. — On both the anterior and posterior aspects of the cord is a median longitudinal cleft, the anterior and posterior median fissures, which mark its divi- Fissures of the cord are,

sion into halves; and along the line of the posterior roots of the nerves, in each half, is another slit, the lateral fissure.

anterior median,

The *anterior median fissure* is wider than the posterior, and penetrates about one third of the thickness of the medulla. It is lined by a fold of the pia mater, and is deepest towards the lower end of the cord. The medullary substance of the surface enters the fissure, lining it; and in the bottom of the cleft the white fibres are transverse, and are separated by apertures for bloodvessels.

posterior median,

The *posterior median fissure* is not so wide, nor so well marked as the anterior, but it is best seen at the upper part of the neck, and in the lower enlargement. The vessels at the posterior aspect of the cord enter this fissure.

and lateral fissure.

The *lateral fissure* (posterior) is situate along the line of attachment of the fibrils of the posterior roots. It reaches inwards to the gray matter in the interior of the medulla.

Supposed other lateral fissure.

Some anatomists describe another *lateral fissure* (anterior) along the line of origin of the anterior roots, but there is not any cleft in that situation.

The cord is divided into

SEGMENTS OF THE CORD.—Each half of the cord, viz. from the anterior to the posterior median fissure, is divided into two parts by the lateral sulcus: the piece in front of that slit and the posterior roots of the nerves is called the antero-lateral column, and the piece behind, the posterior column. A central or commissural piece unites the halves of the medulla.

antero-lateral column

The *antero-lateral column* includes rather more than two thirds of the half of the cord, extending backwards to the posterior roots of the nerves, and gives attachment to the anterior roots.

and posterior column,

The *posterior column* is situate between the posterior roots of the nerves and the central fissure along the posterior aspect of the cord. Near the median fissure, is a slight groove or furrow, which marks off a slender piece, the *posterior median column:* this separation is best seen in the cervical part of the cord.

with commissure.

The *commissure* of the cord is the central piece connecting the halves of the medulla, and limiting the depth of the median fissures.

Different

Different division of the cord. — Each half of the cord is sometimes divided into three parts or columns — anterior,

lateral, and posterior, whose limits are the following: — The anterior reaches from the anterior roots of the nerves to the median fissure in front, and is in a line with the anterior pyramid of the medulla oblongata (p. 203.). The lateral column is limited before and behind by the roots of the nerves, and is continued with that name into the medulla oblongata. The posterior, with its small segment, is placed between the posterior roots and the median fissure behind: above, it is prolonged into the restiform body. division of it.

STRUCTURE OF THE CORD. — A horizontal section of the medulla shows more distinctly the division into halves, with the commissural or connecting piece between them. The same cut demonstrates the existence of white and gray matter in its composition, as in the brain; but it will be at once perceived, that the gray substance is surrounded by the white, instead of being external as in the encephalon. Cord consists of gray and white matter;

a. The *commissural* piece consists chiefly of a transverse band of gray matter, but it has a white stratum at the anterior part. these in commissure.

The gray part consists of nerve cells, and of transverse nerve fibres derived from the opposite halves of the cord and the posterior roots of the nerves. In its centre is a streak or band of a lighter yellow colour, which has been named the *gray nucleus* by Kölliker, and is composed of small multinuclear, and branched cells. Structure of the gray

The white anterior piece of the commissure is formed partly by fibres of the anterior column; and partly by fibrils of the anterior roots of the nerves, which here decussate as they cross from the one half to the other (Kölliker). It is best marked opposite the enlargements on the cord, and least developed in the dorsal region. and of the white part.

b. In the half of the medulla, the gray and white material have the same position to one another as in the commissure, but the former is elongated from before back, and is quite surrounded by the latter. The same in the half of the cord.

The gray matter has the same general structure as that in the commissural piece, and is semilunar or crescentic in shape, with the horns of the crescent directed towards the roots of the nerves, and the convexity to the centre of the cord: the crescentic masses in opposite halves of the cord are united by the commissure. The posterior cornu is long Structure and arrangement of the part. Connections of the crescent.

and slender, and reaches to the fissure along the attachment of the posterior roots: at its extremity it is cased with a more transparent stratum of small nerve cells, which has been named the *substantia gelatinosa* of Rolando. The anterior cornu is shorter and thicker than the other, and projects towards the anterior roots without reaching the surface of the cord.

Substantia gelatinosa.

Arrangement of white matter.

The white covering of the half of the cord is composed chiefly of nerve fibres disposed longitudinally in bundles, so as to give passage to intermediate vessels. By the projection of the cornua of the gray crescent towards the surface, it is separated more or less completely into three parts — anterior, middle, and posterior, corresponding to the columns of the cord; but the anterior and middle portions are united along their line of contact, because the anterior cornu does not reach the surface.

Deep origin of nerves uncertain.

ORIGIN OF THE NERVES. — The deep origin of the spinal nerves is uncertain, like that of the cranial nerves: the fibrils in each root enter the gray matter of the cord, but their precise connection with it has not been made out.*

Anterior roots.

The *anterior roots* penetrate between the anterior and lateral columns into the anterior cornu of the gray mass, and are connected with the anterior column of the opposite side, and the lateral column of the same side in this way: — In the gray matter the fibrils divide into two sets: One is directed inwards, forming part of the white layer on the front of the commissural piece of the cord, and ends in the anterior column of the opposite side; so that the roots of opposite halves of the cord decussate on the front of the commissure. The other more considerable part of the root turns outwards to the fore part of the lateral column of the same side, and its fibres are continuous with it.

from anterior column of other side, with a decussation; and from lateral column of same side.

Posterior roots from hinder and lateral column of

The *posterior roots* enter the cord between the lateral and posterior columns, and are connected with both those columns of the same side, if not of both sides of the cord after passing through the substantia gelatinosa. Thus, as in the other root, the fibrils divide in the gray substance: some of these bend upwards, and become continuous especially with the

* The statement in the text respecting the origin of the nerves, embodies the views of Professor Kölliker. In many respects these correspond with opinions previously held.

posterior column: whilst others, penetrating deeper, are connected with the lateral column, and enter the gray part of the commissure of the cord. By means of the transverse fibres in the commissure the posterior root may be possibly connected, like the anterior root, with the opposite half of the cord.

same side.

Perhaps of opposite.

Neither in the anterior nor in the posterior roots could Professor Kölliker discover any junction of the nerve cells with the nerve fibres, whilst these were in the gray substance.

Do nerve cell, and fibres join?

INTRASPINAL VESSELS. — The arteries in the interior of the spinal canal supply the cord and its membranes, and the bodies of the vertebræ. The veins form a remarkable plexus within the canal, but this will not be seen unless the veins have been specially injected.

Vessels of the spinal canal.

The *intraspinal arteries* are derived from the vessels along the sides and front of the spinal column, viz. from the vertebral and ascending cervical, from the intercostal, and from the lumbar and lateral sacral; and are distributed after the following plan: —

Source of the intraspinal arteries.

As each artery enters the spinal canal by the intervertebral foramen, it divides into two branches, upper and lower: these branches are directed, one upwards and the other downwards, behind the bodies of the two contiguous vertebræ but outside the edge of the posterior common ligament, and join in anastomotic loops with offsets of the intraspinal artery above and below. These loops extend from one intervertebral foramen to another, and furnish branches to the periosteum, and the bodies of the vertebræ on their posterior surface, as well as anastomotic twigs to connect the arches across the vertebræ. Besides forming loops, the intraspinal vessels produce a central longitudinal artery, like that on the front of the spinal cord: this vessel lies on the posterior surface of the bodies of the vertebræ, and is reinforced at intervals by offsets from the loops.

Distribution to the vertebræ and the cord.

The *intraspinal veins* consist of two anterior longitudinal vessels, which extend the whole length of the spinal canal behind the bodies of the vertebræ; of veins from the bodies of the vertebræ; and of a plexus of veins beneath the neural arches of the vertebræ.

Veins within the spinal canal are large.

a. The *anterior longitudinal* veins are close to the bodies of the

Anterior

longitudinal are on bodies of vertebræ. vertebræ, one on each side of the posterior common ligament uniting those bones; and are irregular in outline, owing to certain constrictions near the intervertebral foramina. They receive opposite the body of each vertebra the vein from that bone; and they send outwards, through the intervertebral foramina, branches of communication with the veins outside the spine in the neck, the dorsal region, and the loins.

Veins of the vertebræ. *b. Veins of the bodies of the vertebræ.*— Within the canals in the bodies of the vertebræ are contained large veins, that join on the front of each vertebra with veins in that situation; and unite together, behind, into one trunk, which passes from the bone by the large aperture on the posterior surface. Escaped from the bone, the trunk divides into two branches that diverge,— one to the right another to the left, and open into the large longitudinal veins.

Posterior spinal veins are in contact with arches. *c.* The *posterior spinal veins* form a plexus between the dura mater and the arches of the vertebræ. A large vein may be said to lie on each side of the middle line, which joins freely with its fellow, and with the anterior longitudinal vein by lateral branches. Into this plexus the small veins on the outside of the neural arches pour their contents. Branches from these vessels are directed to the intervertebral foramina, where they end in the veins at the roots of the transverse processes.

CHAPTER VII.

DISSECTION OF THE PERINÆUM.

Section I.

PERINÆUM OF THE MALE.

Directions. — The perinæum may be allotted with greatest advantage to the dissector of the abdomen; and its examination should be made before that of the abdomen, as the distinctness of many of the parts is destroyed soon after death. Before the body is placed in the position suited for the dissection, the student may practise passing the catheter along the urethra. Before the dissection pass catheter.

Position of the body. — Whilst the body lies on the back it is to be drawn to the end of the dissecting table, till the buttocks hang slightly over the edge. A moderately-sized block is then to be placed beneath the pelvis, to raise the perinæum to a convenient height. The legs are to be raised and kept out of the way by the following means: — After the thighs are bent upon the trunk, and the knees also bent, the limbs are to be fastened in that position with a cord. For this purpose make one or two turns of the cord round one bent knee (say the right), carry the cord beneath the table, and encircling the opposite limb in the same manner, fasten it finally round the right knee. When the position has been arranged, let the student raise the scrotum, and place a small bit of cotton wool or tow within the anus, but let him avoid distending the rectum. Place the body in position, and fasten upwards the legs.

Superficial limits, and marking of the surface. — The perinæal space in the male is limited, on the surface of the body, by the scrotum in front, and by the thighs and buttocks on the sides and behind. This region is of a dark colour, and is covered with hairs. About its centre is the aperture The surface presents

of the anus, which is posterior to a line extended from the anterior part of the one ischial tuberosity to the other. In front of the anus the surface is slightly convex over the urethra, and presents a longitudinal prominent line or *raphé*, which divides this part of the space into two halves. Between the anus and the tuberosity of the hip-bone the surface is somewhat depressed, especially in emaciated bodies, and corresponds to the hollow of the subjacent ischio-rectal fossa. The margin of the anal aperture possesses numerous converging folds, but these are more or less obliterated by the position of the body and the distension of the rectum; and projecting oftentimes through and around the opening are some dilated hæmorrhoidal veins (hæmorrhoids).

the anus, a raphé, hollow on side of anus, and folds and veins around that opening.

Bounding parts around, same as those of outlet of pelvis.

Deep boundaries. — The deep boundaries of the perinæal space will be ascertained, in the progress of the dissection, to correspond with the inferior aperture or the outlet of the pelvis. The limits may be made out by referring to a dry or prepared pelvis, on which the ligaments remain entire; and the student should trace on the body, the individual boundaries with his finger. In front is the arch of the pubes; and at the posterior part is the tip of the coccyx. On each side, from before backwards, is that portion of the innominate bone which forms the pubic arch, viz. from the pubes to the ischial tuberosity; and still farther back is the great sacro-sciatic ligament extending from the tuber ischii to the tip of the coccyx.

Form of the space, and measurements.

Form. — The space included within these boundaries has the form of a lozenge, and measures about four inches from before backwards, and three inches between the ischial tuberosities. A line from the front of the tuberosity of one side to the corresponding point on the other, will divide the perinæal space into two triangular parts. The anterior (urethral) half contains the penis and the urethra, with their muscles and accessory parts. The posterior (rectal) half is occupied by the lower end of the large intestine, with its muscles, &c.

A line between the tuberosities divides it into two.

Depth of the space.

Depth. — The depth of the perinæum from the surface to the bladder may be said to be generally about three inches, but this measurement varies much in different bodies.

POSTERIOR HALF OF THE SPACE.

This portion of the perinæal space contains the lower end of the rectum, surrounded by its elevator muscle and the muscles acting on its opening—the anus. The gut, however, does not occupy the whole of the interval between the pelvic bones; for on each side is a space, the ischio-rectal fossa, in which is much loose fat, together with the vessels and nerves that supply the end of the gut. Contents and general position.

Dissection.—The skin is to be raised from this division of the perinæum by the employment of the following cuts:—One is to be made across the perinæum at the front of the anus, and is to be extended rather beyond the ischial tuberosity on each side; a second is to be carried a little behind the tip of the coccyx, in the same direction and for the same distance. The two transverse cuts are then to be connected by carrying the knife along the middle line and around the anus. The flaps of skin, thus marked out, are to be raised and thrown outwards from the middle line: in detaching the skin from the margin of the anus, the superficial sphincter muscle may be injured, without care, for it is close to the skin. The dissector should first trace that muscle back to the coccyx, and then forwards beneath the remaining piece of skin. Dissection of sphincter ani.

The next step is to bring into view the hollow of the ischio-rectal fossa, between the side of the rectum and the tuberosity of the hip-bone: on the left side the fat is to be cleared out of it without reference to the vessels and nerves, but on the opposite side a special dissection is to be made of them. To clean out the fat from the left fossa, begin at the outer margin of the sphincter, and from that point proceed forwards and backwards. In front the dissection should not extend beyond the anus, whilst behind it should lay bare the margin of the gluteus maximus. On the inner side of the hollow the fibres of the levator ani (sometimes very pale) and of the coccygeus are to be dissected; and on the outer boundary, the pudic vessels should be denuded, as they lie in a canal formed by fascia, and at some distance from the surface. Difference in exposing the ischio-rectal fossæ. Dissection of left ischio-rectal fossa,

On the opposite side it is not necessary to clean the mus- and of

that on right side, seeking vessels and nerves. cular fibres when following the vessels and nerves. If the student begins at the outer border of the sphincter, he will find the inferior hæmorrhoidal vessels and nerve, which he may trace outwards to their trunks (pudic vessels and nerve): some branches of the nerve are to be followed forwards to their junction with two other nerves, the superficial perinæal and inferior pudendal. In the posterior angle of the space there is a small offset of the fourth sacral nerve; and sometimes, external to it, one or more branches of the sciatic nerve and artery are found turning round the border of the gluteus. Near the front of the fossa is a superficial perinæal artery and nerve (of the pudic); and the last, after communicating with the hæmorrhoidal nerve, leaves the fossa in front. The trunks of the pudic vessels and nerve may be laid bare on the outer wall.

Situation of the fossa. The *ischio-rectal fossa* is the space intervening between the rectum and the ischial part of the innominate bone. On

Form. a vertical section the interval would appear to be triangular,

Dimensions. with its apex above and its base towards the surface. Its width is about one inch at the base, and its depth about two inches; but it is larger behind than before. It is filled

Boundaries. by a soft granular fat. The inner side of the space is very oblique, and is bounded by the levator ani and coccygeus muscles, and slightly by the sphincter; but the outer side is straight, and corresponds to the obturator muscle and the fascia covering it. In front it is limited by the triangular ligament (to be afterwards seen); and behind by the great sacro-sciatic ligament and the largest gluteal muscle.

Pudic vessels on the outer wall, *Position of vessels.* — Along the outer wall are the pudic vessels and nerve; these lie in a tube of fascia, being one inch and a half from the margin of the ischial tuberosity, but towards the front of the space they approach near the

and nerves in the space. edge of the pubic arch. Crossing the centre of the space are the inferior hæmorrhoidal vessels and nerve, — branches of the pudic. At the anterior part, for a short distance, is one superficial perinæal nerve (of the pudic); and at the posterior part is a small branch of the fourth sacral nerve.

First cut in lithotomy enters this space. Into this space the surgeon sinks his knife in the first incisions in the lateral operation of lithotomy; and as he carries the knife from before backwards, he will divide the superficial hæmorrhoidal vessels and nerve.

MUSCLES.— Connected with the lower end of the rectum are three muscles, two sphincters (external and internal) and the levator ani. Muscles of rectum.

The EXTERNAL SPHINCTER (sphincter ani externus) is a flat, thin, orbicular muscle, which is pointed in front and behind, and surrounds the lower part of the rectum. As in other orbicular muscles, the fibres form ellipses around a central aperture. The muscle *arises* posteriorly from the tip of the coccyx by a fibrous band, and from the superficial fascia in front of that bone. The fibres pass forwards to the anus, where they separate to encircle that aperture, and having united in front of it, are *inserted* into the superficial fascia and the central point of the perinæum. The sphincter is close beneath the skin, and partly conceals the levator ani. The outer border projects over the ischio-rectal fossa, and the inner is contiguous to the internal sphincter. External sphincter surrounds rectum. Origin. Insertion. Connections.

The INTERNAL SPHINCTER (sphincter ani internus) is situate around the extremity of the intestine, internal to the preceding muscle, and its edge will be seen by removing the mucous membrane. The fibres of this muscle are pale, non-striated, and of a finer texture than those of the other sphincter: they encircle the lower part of the rectum in the form of a band, and are quite separate from the surrounding voluntary muscular fibres. The muscle is only a thickened band of the involuntary circular fibres of the large intestine, which is about half an inch in depth. Internal sphincter is a pale band around the end of the gut. Is part of fibres of intestine.

The LEVATOR ANI muscle can be seen now only in part, and the external sphincter should be detached from the coccyx, in order that its insertion may be more apparent. The muscle descends from the inner aspect of the innominate bone, and is *inserted* below along the middle line, from the coccyx to the central point of the perinæum. The most posterior fibres are connected to the side of the coccyx; and between that bone and the rectum the muscles of opposite sides are united in a median tendinous line. The middle fibres are blended with the side of the intestine (rectum). Whilst the anterior are joined with the fibres of the opposite muscle, in front of the rectum, in the central point of the perinæum. This muscle bounds the ischio-rectal fossa on the inner side. Insertion of levator ani to coccyx, to tendon in front of it; to rectum, and to centre of perinæum.

ARTERIES.— The inferior hæmorrhoidal is the only named Arteries

of the space. branch of the pudic artery that is now dissected. Some other small branches of the pudic and sciatic are also seen.

Inferior hæmorrhoidal The *inferior hæmorrhoidal artery* arises from the trunk of the pudic, internal to the ischial tuberosity; it divides into branches that pass inwards across the ischio-rectal fossa, and end in the skin, and the sphincter and levator ani muscles. On the rectum this artery anastomoses with the upper hæmorrhoidal branch, and with the artery of the opposite side. In a well-injected body, some cutaneous branches may be seen to run forwards to the anterior part of the perinæum, and to communicate with the superficial perinæal branch. *Veins* accompany the artery.

ends on rectum and in its muscles.

Branch of vein.

Other offsets of pudic. Other small *muscular* branches of the pudic artery cross the front of the ischio-rectal fossa, and supply the anterior part of the levator ani muscle.

Branches of the sciatic. *Branches of the sciatic artery* appear on the inner aspect of the gluteus maximus at the back of the fossa; some end in that muscle, and others are continued round its border to the surface.

Nerves. NERVES.—The branches of nerves are the inferior hæmorrhoidal; an offset of the fourth sacral nerve; and some branches of the small sciatic nerve.

Inferior hæmorrhoidal is with artery of same name. The *inferior hæmorrhoidal nerve* is most frequently a branch of the pudic, though it may have a separate origin from the sacral plexus. Accompanying the artery of the same name across the ischio-rectal fossa, it reaches the margin of the anus, where it terminates in offsets to the integument and the sphincter muscle. Other cutaneous offsets of the nerve turn forwards over the fossa, and communicate with the superficial perinæal nerve, and with the inferior pudendal (of the small sciatic) on the margin of the thigh.

Termination.

Branch of sacral nerve The *hæmorrhoidal branch* of the *fourth sacral nerve* reaches the ischio-rectal fossa by piercing the fibres of the coccygeus, or by passing between that muscle and the levator ani. Appearing in the posterior part of the fossa, close to the coccyx, the nerve ends by supplying the external sphincter, and the integument behind the anus.

supplies sphincter.

Offsets of small sciatic. One or two *cutaneous branches* of the *small sciatic nerve* turn round the lower border of the gluteus, in their course to the teguments on its surface.

ANTERIOR HALF OF THE PERINÆAL SPACE.

In the anterior part of the perinæal space the tube of the urethra is lodged, as this passes from the interior of the pelvis to the surface of the body. Placed about midway between the bones, the tube is supported by a fibrous structure named the triangular ligament. Muscles are collected around it, to aid in the expulsion of the urine: some of these are before, and some within the triangular ligament before alluded to. The vessels and nerve lie, as in the posterior half, along the outer side, and send inwards offsets. Contents and general position of parts.

Supporting the anterior part of the urethra is the penis: this body and its muscles and vessels have to be examined generally with the other contents of this half of the perinæal space.

Dissection. — To raise the skin from the anterior part of the perinæum, a transverse cut is to be made at the back of the scrotum, and continued for a short distance (two inches) on each thigh. A second incision along the middle line will allow the flaps of skin to be reflected. Incisions to raise the skin.

After the reflection of the skin the superficial fascia, which covers the front of the perinæal space, is to be blown up by means of a blow-pipe introduced beneath it at the posterior part. Each side is to be inflated to demonstrate the fact that a partition exists in the middle line: at the same time, it will be evident that there is another partition between the perinæal space and the thigh, for the air does not pass along the limb. The student is next to cut through the superficial fascia on the left side, from the scrotum to the ischio-rectal fossa, and to remove some loose and fatty tissue, to bring into view the line of attachment of that fascia to the bones externally, and to the triangular ligament posteriorly: the septum along the middle line should also be defined. To demonstrate more completely the partition of the superficial fascia between the perinæal space and the thigh, which is connected with the pubic arch, it will be necessary to take away, on the left side, the fat from the fascia lata of the thigh, external to the line of the bones before mentioned. Blow up superficial fascia and reflect it. Define partition between thigh and perinæal space.

In the fat of the thigh on the right side, the student On right side seek

inferior pudendal nerve. should seek the inferior pudendal nerve, which pierces the fascia lata about one inch anterior to the tuber ischii, and the same distance from the margin of the pubic arch; and should trace its junction with the inferior hæmorrhoidal nerve in the fat. Afterwards this nerve is to be followed forwards to where it enters beneath the superficial fascia in the middle line.

Superficial fascia. Its thickness varies. Resembles that of groin, in having two layers. The *superficial fascia* of the anterior half of the perinæum is continuous with that of the contiguous regions; and its depth, and the quantity of fat in it will vary with the condition of the body. It resembles the superficial fascia of both the groin and the upper part of the thigh, in having two strata; — one is a subcutaneous fatty stratum, continuous with that in other parts of the body, which loses its fat towards the fore part, and contains involuntary muscular fibres; and the other is a deeper membranous layer, which is of limited extent, and is connected with the firm subjacent structures.

Connections of deep layer. An examination of the deep or membranous stratum will show it to have the following attachments: — On the outer side it is fixed to the pubic arch of the hip-bone, external to the line of the crus penis and its muscle, extending as low as the ischial tuberosity. Posteriorly the stratum bends down to join the triangular ligament of the perinæum; but in front it is unattached, and is continued to the scrotum and the penis. Forms a pouch, open in front; this divided by a septum. By means of similar connections on both sides, a pouch is formed over the anterior half of the perinæal space underneath the superficial fascia. From the under surface of this part of the fascia a septum dips downwards in the middle line, and divides the subjacent space posteriorly into two parts; but anteriorly this partition is less perfect or disappears. Air blown beneath the fascia has been seen to pass only forwards to the scrotum; and this direction is given to it by the connections of the deep layer with the parts around. Course of effused urine. Should urine be effused beneath the membranous part of the fascia, the fluid will necessarily be directed forwards, like the air, through the scrotum, to the penis and the front of the abdomen.

Dissection of nerves and vessels on *Dissection.* — The superficial vessels and nerves are to be traced beneath the superficial fascia, on the right side of the perinæum, by cutting through that structure in the same

manner as on the left side. One long slender artery is the superficial perinæal, which gives a transverse branch near its commencement: sometimes there are two superficial branches. Two superficial perinæal nerves are to be found with the artery; and the inferior pudendal is to be traced forwards to the scrotum. Communications are to be sought between these nerves anteriorly, and between one of the perinæal and the inferior hæmorrhoidal posteriorly; and all the nerves are to be followed back to their origin. right side.

ARTERIES.—The arteries beneath the fascia, viz. superficial and transverse perinæal, are branches of the pudic, and are two or three in number. Superficial vessels of pudic.

The *superficial perinæal* branch is given off from the pudic artery in front of the branch to the rectum. Perforating usually the base of the triangular ligament, it turns forwards over or under the transverse muscle, and beneath the superficial fascia, to the back of the scrotum, where it ends in flexuous branches for that part. As the vessel lies beneath the fascia, internal to the pubic arch, it supplies offsets to the muscles beneath; and in front, it anastomoses with the external or superficial pudic branches of the femoral artery. Sometimes there is a second superficial perinæal branch. Superficial perinæal ends in scrotum, and supplies the muscles.

At the origin of the superficial perinæal, some other *muscular branches* pass inwards to the front of the levator ani (p. 448.). Other muscular branches.

The *transverse artery* of the perinæum arises from the preceding, or at the same spot, and is directed transversely to the middle of the perinæal space, where it is distributed to the integuments and the transverse muscles. It anastomoses with the one of the opposite side. Transverse artery.

Branches of *veins* correspond with those of the artery, and open into the trunk of the pudic vein. Veins with the arteries.

NERVES.—There are three long cutaneous nerves of the scrotum, viz. the inferior pudendal from the small sciatic, and two superficial perinæal branches from the pudic nerve. Cutaneous nerves of scrotum.

The *superficial perinæal nerves*, two in number, are named anterior and posterior from their relative position at their origin: both arise from the perinæal branch of the pudic nerve. Two superficial perinæal.

a. The *posterior branch* appears near the front of the ischio-rectal fossa, and entering beneath the superficial fascia, is continued for- Posterior

crosses over fossa to the scrotum, wards with the artery of the same name to the back of the scrotum. Whilst in the fossa, the nerve gives inwards an offset to the integuments in front of the anus, and this communicates with the inferior hæmorrhoidal nerve.

and anterior has same anatomy as posterior; *b.* The *anterior branch*, appearing somewhat farther forwards than the other, passes either over or under the transverse muscle, and accompanies the posterior branch to the scrotum. At its origin muscular offsets are furnished to the levator ani muscle.

muscular branches; Other *muscular branches* arise from the pudic nerve at the same spot as the preceding nerve, but these will be afterwards examined.

both are joined and distributed to scrotum and penis. The superficial perinæal branches communicate with one another, and the posterior one is joined by the inferior pudendal nerve. At the scrotum they are distributed by long slender filaments, some of which reach as far as the under surface of the penis. In the female these nerves supply the labia pudendi.

Inferior pudendal nerve The *inferior pudendal nerve* is a branch of the small sciatic: it pierces the fascia lata about one inch in front of the ischial tuberosity, and coursing forwards along the inner part of the thigh, enters beneath the superficial fascia of the perinæum; finally, it passes forwards with the superficial perinæal nerves, and ends in the outer part and front of the scrotum. A communication takes place between this nerve and the posterior of the two superficial perinæal branches. In the female the inferior pudendal nerve is distributed to the labium.

ends in scrotum, and joins superficial perinæal.

Other offsets of small sciatic. On the surface of the thigh some other offsets (internal branches) of the small sciatic nerve may be observed.

Dissection of muscles of the urethra and penis. *Dissection.*—For the dissection of the muscles, the superficial fascia, as well as the vessels and nerves that have been examined, must be taken away from the anterior half of the perinæal space: it will be also necessary to remove a thin subjacent aponeurotic layer from the muscles. The muscle in the middle line is the accelerator urinæ; and in cleaning it the student is to follow two fasciculi of fibres, which are prolonged from it, one in front, the other behind. On the outer side of the space is the erector penis; and behind, passing horizontally between the other two, is the transverse muscle.

Of nerves. The student should seek, on the right side, the branches of nerves to the muscles: to the erector penis there is a sepa-

rate branch, and beneath the transversalis is the offset that supplies the other two muscles and the urethra.

MUSCLES. — Superficial to the triangular ligament, in the anterior half of the perinæal space, are three muscles, viz. the erector penis, the accelerator urinæ, and the transversalis perinæi. Other muscles of the urethra are between the layers of the triangular ligament and will be subsequently seen. Three muscles above triangular ligament.

Central point of the perinæum. — Between the urethra and the rectum is a white fibrous spot, to which this term has been applied. It occupies the middle line, being, as the name expresses, nearly in the centre of the perinæum: in it most of the muscles acting on the rectum and the urethra are united; and it serves as a common point of support to the space. Central point: where muscles join.

The ERECTOR PENIS is the most external of the three muscles, and is narrower at each end than in the middle. It covers the crus penis, and its fibres *arise* from the inner surface of the ischial tuberosity farther back than the attachment of the crus of the penis, and from the bone on each side of the crus. Superiorly the muscle ends in an aponeurosis, and is *inserted* into the inner and outer surfaces of the crus penis. The muscle rests on the crus of the penis and the bone. Erector penis. Origin. Insertion.

The ACCELERATOR URINÆ muscle lies on the urethra along the middle line of the perinæum. The muscles of opposite sides join through the interposition of a median tendon. Each muscle is attached to the common tendon along the middle line, and to the central point of the perinæum. The fibres are directed outwards, curving around the convexity of the urethra, and give rise to a thin muscle, which has the following *insertion:* — The most posterior fibres are lost on the anterior surface of the triangular ligament. The anterior fibres, which are the longest and best marked, turn round the penis to be inserted on its outer aspect anterior to the erector; and, according to Kobelt*, they send a tendinous expansion over the dorsal vessels of the penis. Whilst the middle or intervening fibres turn round the urethra, passing between the spongy and cavernous bodies of the Accelerator urinæ. Origin at middle line. Insertion by three parts.

* *Die Männlichen und Weiblichen Wollust-Organe,* von G. L. Kobelt, 1844.

penis, and join in a central tendon with the muscle of the opposite side. The accelerator muscle covers the bulb, and the urethra for two inches in front of the triangular ligament. If the muscle be cut through on the right side, and turned off the urethra, the junction with its fellow above that tube will be apparent.

Covers the urethra, and surrounds it as in a sling.

Compressor of the bulb.

Some of the deeper fibres, that immediately surround the bulb, have been described as a separate stratum by Kobelt. These are separated from the superficial by thin connective tissue, and join the corresponding part of the opposite side by a small tendon above the urethra. The name *compressor hemisphærium bulbi* has been proposed for it by that anatomist.

Transversalis perinæi.

Origin.

Ends in central point of perinæum.

The TRANSVERSALIS PERINÆI is a small thin muscle, which lies across the perinæum opposite the base of the triangular ligament. *Arising* by a tendon from the inner aspect of the pubic arch near the ischial tuberosity, the fibres run inwards, and join in the central point of the perinæum with the muscle of the opposite side, and with the sphincter ani and the accelerator urinæ. Behind this muscle the superficial fascia dips down to join the triangular ligament.

Accessory transversalis.

Sometimes there is a second small muscular slip anterior to the transversalis, which has been named *transversalis alter;* this throws itself into the accelerator muscle.

A triangular space between the three muscles described.

The knife may enter this in lithotomy.

Now the three muscles above described have been separated from one another by the dissection, they may be seen to enclose a triangular space, of which the accelerator urinæ forms the inner boundary, the erector penis the outer side, and the transversalis perinæi muscle the base. In the area of this interval is the triangular ligament of the urethra, with the superficial perinæal vessels and nerves. Into the posterior part of this space the knife may enter during the deeper incisions in the operations of lithotomy; and as the instrument is carried backwards in the direction of the external incision, it will cut the transverse muscle and artery, and probably the superficial perinæal vessels and nerves.

Dissection to see triangular ligament.

Dissection.—For the display of the triangular ligament, the structures that are superficial to it, viz. the muscles and the crus penis, are to be detached in the following way:—On the left side the accelerator urinæ is to be removed completely from the front of the ligament, and the erector muscle

from the crus of the penis. The same steps may be repeated on the right side, if it is thought desirable; but the dissector should observe, before cutting away the muscles, the branches of the nerve to them: one nerve is also to be traced to the urethra. Next, the crus penis is to be detached from the bone on the left side; but this must be done with care so as not to cut at the same time the triangular ligament, and not to injure near the pubes the terminal parts of the pudic artery and nerve to the penis.

Triangular ligament of urethra. Extent and form. The *triangular ligament of the urethra* (perinæal aponeurosis) occupies the anterior part of the pubic arch, and supports the urethral canal. The ligament is of a triangular form, with the apex above and the base below; and is about one inch and a half in depth. On the sides it is fixed to the subpubic arch, beneath the crura penis. Its apex is connected with the symphysis pubis. Its base is turned towards the rectum, and is partly attached and partly free;—in the middle line it is connected with the central point of the perinæum, whilst laterally it is sloped towards the bone, so that it is less deep at the centre than at the sides: connected with the lower border, is a thin fascia which covers the surface of the levator ani muscle in the ischio-rectal fossa. Superficial to it are the muscles in the anterior half of the perinæal space, and the superficial fascia is united to it near the lower border. Perforating the ligament about one inch below the symphysis pubis is the canal of the urethra, but the margin of the opening giving passage to the tube is blended by means of fibres with the tissue of the corpus spongiosum urethræ. About midway between the preceding opening and the symphysis pubis, is the aperture for the dorsal vein of the penis; and external to the last, near the bone on each side, the terminal parts of the pudic nerve and artery to the penis perforate the ligament. The triangular ligament is composed of two layers of fibrous membrane (anterior and posterior) which are united only below, and protect the membranous part of the urethra. The posterior layer is derived from the pelvic fascia; the anterior is a separate structure, and consists chiefly of transverse fibres, but it is so thin as to allow the vessels and the muscular fibres to be seen through it. Between the layers of the ligament are the membranous part of the urethra, with its

Attachments. Parts over it. Apertures in it for urethra, for dorsal vein and vessels and nerves. Consists of strata. Parts between.

muscles, vessels and glands, and the bloodvessels and nerves of the penis, as the subsequent dissection will show.

Dissection.

Dissection. — The muscles connected with the urethra between the layers of the ligament will be reached by cutting through with care, on the left side, the superficial stratum near its attachment to the bone, and raising and turning inwards that piece of membrane. By a little cautious dissection, and the removal of some veins, the following objects will come into view with the undermentioned position: —

Parts between triangular ligament.

Parts between the layers of the ligament. — Near the base of the ligament is a narrow transverse muscle, which is directed to the bulb of the urethra. Coming inwards to the urethra, from behind the pubic arch, is the fasciculus of fibres of the compressor urethræ muscle, which surrounds the membranous part of the urethra. And below the urethra are the glands of Cowper. Beneath the bone (pubic arch) are the pudic vessels and nerve, the former giving its branch to the bulb; and below the pubes is the subpubic ligament. Deeper than all, the student will be able to recognise the posterior layer of the ligament, continuous with the pelvic fascia which separates these parts from the cavity of the pelvis.

Muscles of urethra.

Muscles. — The muscles between the layers of the triangular ligament, which are connected with the membranous part of the urethra, are two in number, viz. a deep transverse muscle, and a constrictor of the urethral passage.

Deep transverse.

The deep transverse muscle of the perinæum (elevator urethræ, Santorini) is a thin flat band, on a level with the base of the triangular ligament. It *arises* externally from the pubic arch of the innominate bone, and is directed inwards below the tip of the bulb and the membranous part of the urethra; it joins (sometimes by a tendon) the muscle of the opposite side, and is inserted into the central point of the perinæum. This muscle conceals Cowper's gland near the bulb, and is frequently placed over the artery of the bulb.

Origin.

Termination.

Constrictor of urethral passage has two parts.

The constrictor muscle of the urethra (constrictor isthmi urethralis) encloses the membranous part of that tube, from the bulb to the prostate gland. It consists of transverse fibres, both above and below the urethra, which are connected on each side to the subpubic arch. Internal to

it is a layer of circular fibres around the urethra which are not fixed to bone.*

The *transverse* part of the muscle arises by aponeurotic fibres from the subpubic arch above the preceding, for the distance of half an inch; but this attachment is not very evident unless the muscle has been dissected from behind. From this origin the fibres pass inwards, and separate near the urethra into two layers, of which one passes over, the other under that canal; in the middle line these unite, sometimes by tendinous bands, with the muscle of the opposite side. Or the fibres may be described as extending across the perinæum from the one lateral attachment to the other, and enclosing the tube of the urethra in their passage, like the sphincter ani encircles the rectum. Transverse part arises from pubic arch, and ends in middle line, over and under urethra.

The *circular* fibres surround the urethra between the bulb and the prostate, and form a layer about $\frac{1}{30}$th of an inch thick; they are involuntary in their nature, and are continuous behind with the circular fibres of the prostate and the bladder. External to these are the voluntary or transversely striated fibres of the constrictor. Circular fibres of urethra.

This layer is usually described as part of the constrictor. Its fibres are, however, involuntary instead of voluntary as in the constrictor. It appears to be only a portion of a large involuntary orbicular or constrictor muscle, of which the prostate is part, surrounding the beginning of the urethra.†

The *glands of Cowper* will be found by cutting through the transverse muscle: they are situate below the membranous part of the urethra, one on each side of the middle line, and close behind the bulb. Each gland is about the size of a pea, and is made up of many small lobules. Connected with each is a minute duct, nearly an inch in length, which perforates obliquely the wall of the urethra (corpus spongiosum), and opens into the urethral canal about half an inch in front of the triangular ligament: the aperture of the Cowper's gland. Situation and size. Length and termination of the duct.

* Further information respecting this muscle may be obtained by consulting the *Septemdecim Tabulæ* of Santorini; a Paper by Mr. James Wilson, in the first volume of the *Med. Chirur. Transactions;* the Work of Mr. Guthrie, *On the Anatomy and Diseases of the Neck of the Bladder and Urethra;* and the Treatise of J. Müller, *Ueber die Organischen Nerven der erectilen Männlichen Geschlechts-Organe, &c.*

† See a Paper on the Arrangement of the Muscular Fibres of the Urethra, &c., in vol. xxxix. of the *Trans. of the Med. Chir. Society,* 1856.

duct in the ordinary state of the parts does not admit a bristle. These bodies are sometimes so small as to escape detection, and they appear to decrease in size with advancing age.

Dissection of the pudic vessels and nerve.

Dissection. — The student may complete the examination of the perinæum by tracing out the pudic vessels and nerve, and their remaining branches. From the point of its division into two branches (dorsal branch of the penis, and branch of the corpus cavernosum) beneath the crus, the artery is to be followed backwards along the outer wall of the right ischio-rectal fossa. The pudic nerve will be exposed at the same time, and should any of the branches be already cut away, the corresponding ones may be sought on the opposite side.

Pudic artery

The *pudic artery* is a branch of the internal iliac; it enters the perinæal space through the small sacro-ischiatic notch, and is distributed to the perinæum and the genital organs.

courses along pubic arch

Entering the posterior part of the ischio-rectal fossa, the artery extends forwards along the outer wall about one inch and a half above the ischial tuberosity, and is contained in an aponeurotic canal which attaches it to the fascia covering the obturator muscle: but at the base of the triangular ligament the vessel is much nearer the margin of the pubic arch. It then ascends between the layers of the triangular ligament, and along the pubic arch nearly to the subpubic

and ends on penis.

ligament, where it perforates the superficial part of the triangular ligament, and divides into the artery of the body, and that of the dorsum of the penis.

Branches not yet seen are:

The *branches* of the vessel in the perinæal space are numerous. The superficial offsets, viz. inferior hæmorrhoidal, transverse perinæal, and superficial perinæal, have been examined: the remaining, for the supply of the penis and the urethra, are subjoined: —

Artery of bulb between triangular ligament.

The *artery of the bulb* of the urethra is a branch of considerable size, and arises near the base of the triangular ligament. Passing almost transversely inwards between the layers of the ligament, and about half an inch from its base, the artery reaches the bulb of the urethra, and enters the spongy structure. Near the urethra it furnishes a small branch to Cowper's gland.

Its situation varies.

The distance of this branch from the base of the ligament depends upon its origin at a point nearer the front or back of the perinæal space. If the vessel arises farther behind than usual, it

may be altogether below the base of the ligament, and cross the front of the ischio-rectal fossa; but if it arises more anteriorly, as when it comes from an accessory pudic branch (see below), its position will be higher than the level of the bulb. From the size of the vessel its place is important in the operation of lithotomy: in the case first mentioned, it would be liable to be cut across, whilst in the last it would be altogether out of the way of the knife. The importance of this in lithotomy.

The *artery of the cavernous structure* of the penis (art. corporis cavernosi) is one of the terminal branches of the pudic. At first this small vessel lies between the crus penis and the bone, but it soon enters the cavernous structure of the penis, and ramifies in it. Artery of body of penis.

The *dorsal artery of the penis* is in direction and size the continuation of the pudic; it runs upwards like the preceding between the crus penis and the bone, and reaches the dorsum of the penis by passing through the suspensory ligament. Its distribution with the accompanying nerve is noticed at page 471. It is much smaller in the female than in the male. Artery of dorsum of penis.

Accessory pudic. — In some cases the pudic is not large enough to supply all the branches above described to the penis and the urethra. One or more offsets will be then contributed by an accessory artery, which leaves the pelvis in front by piercing the triangular ligament. The source of this accessory artery is in the internal iliac. Accessory pudic artery, source.

The *pudic vein* has the same connections, and the same branches as the artery, with the exception that the dorsal vein of the penis does not join it. Pudic vein.

The *pudic nerve* is derived from the sacral plexus, and distributes offsets corresponding to the branches of the pudic artery. Accompanying the bloodvessels, the nerve enters the posterior part of the ischio-rectal fossa, and supplies there the inferior hæmorrhoidal (p. 448.), and a large perinæal branch. Much diminished in size, it continues with the artery without branching, pierces the triangular ligament of the urethra near the pubes, and is continued onwards to the dorsum of the penis with the dorsal branch of the pudic artery; its termination is described at page 471. The following are its offsets: — Pudic nerve is with artery and ends like it on penis.

The *perinæal branch* is distributed to the perinæum: it first supplies the superficial perinæal nerves, which have been already seen (p. 451.), and then extends forwards below the pudic artery, nearly to the base of the triangular ligament, where it ends in offsets to the muscles, as well as to the bulb of the urethra. Perinæal branch ends in the following

muscular offsets. *Muscular branches.* — One turns outwards to enter the under surface of the erector penis; others pass beneath the transversalis, supplying it and the accelerator urinæ; and one or two other slender filaments pierce the triangular ligament, and supply the muscles beneath it.

Nerve of the bulb. The *nerve of the bulb* is a long slender branch that supplies, like the artery, the spongy structure investing the canal of the urethra. Some of its filaments run for a great distance on the surface before entering the corpus spongiosum urethræ.

Parts cut in lithotomy. *Parts cut in the lateral operation of lithotomy.* — A review of the relative position of the parts in the perinæum will indicate those that must be injured in reaching the bladder, and those that are to be avoided.

In cutting from the surface to the staff, In making the external incisions the knife is entered in the middle line of the perinæum, one inch in front of the anus, and is drawn backwards, on the left side, to midway between the ischial tuberosity and the anus. In this proceeding the skin and the superficial fascia, and the inferior hæmorrhoidal vessels and nerves lying across the ischio-rectal fossa would be cut; and the transverse perinæal muscle and artery, with, possibly, the superficial perinæal vessels and nerves may be then divided. In the subsequent attempt to reach the staff, when the knife is introduced into the anterior part of the wound, the lower part of the triangular ligament, the deep transverse urethral muscle, and and in running knife along staff into bladder. the fore part of the levator ani will be divided; and when the knife is placed within the groove of the staff, the membranous part of the urethra, with the muscular fibre about it, will be cut. Lastly, as the knife is pushed along the staff into the bladder, it incises in its progress the membranous division of the urethra, and part of the prostate with the large veins around it.

Parts to be avoided are rectum, The several parts to be avoided in the stages of the operation are the following: — In the first incisions in the ischio-rectal fossa, the rectum may be cut if the knife is turned inwards across the intestine, instead of being kept parallel with it, and if the gut is not kept out of the way with the pudic vessels, fore finger of the left hand. The pudic vessels on the outer wall of the ischio-rectal fossa may be wounded near the anterior part of that hollow, where they approach the margin of the triangular ligament; but, posteriorly, they are very securely lodged inside the projection of the tuber ischii.

Whilst making the deeper incisions to reach the staff, the bulb and its artery lie immediately in front of the knife, and will be entered if the incisions are made too far forward; but the artery must necessarily be cut, when it arises farther back than usual, and crosses the front of the ischio-rectal fossa in its course to the bulb of the urethra. In dividing the prostate gland the edge of the knife is to be turned outwards and downwards, in the direction of a line from the urethra through the left lateral lobe of that body, and so as not to injure the ejaculatory duct below. The upper part of the prostate and its fibrous capsule are not to be cut through, otherwise the urine may be effused beneath the peritoneum, and the vessels on the exterior may be divided.

bulb and its artery, ejaculatory duct. Capsule of the prostate gland.

Directions. — When the dissection of the perinæum is completed, the flaps of skin are to be fastened together, after some preservative fluid has been used, and the limbs are to be put down.

Directions.

Section II.

PERINÆUM OF THE FEMALE.

In the female the perinæum differs from the like region in the male more in the external form than the internal anatomy; but it has special parts distinguishing it, viz. the aperture of the vagina surrounded by its sphincter, and the aperture of the vulva with the labia.

Perinæum of female has special parts.

Surface-marking. — On the surface of the perinæal space in the middle line, there are two apertures, viz. those of the anus and vulva, which are separated from one another by an interval of about an inch; the former is situate relatively rather farther back than in the male, and the vulva is in the situation of the scrotum of the other sex. Bounding the vulva are the labia majora, one on each side. Within the vulva, at the upper part, is the clitoris, with two small membranous folds, labia minora, extending downwards from it. Below the clitoris is the small aperture of the urethra; and still lower down is the vagina, whose opening is sometimes partly closed by a thin piece of membrane, the hymen.

Along middle, apertures of anus and vulva. Parts within vulva.

Deep boundaries.—The deep boundaries of the perinæum

Parts bound-

ing space are same in both sexes. are alike in both sexes; but in the female the outlet of the pelvis, corresponding to the perinæum, is larger than that of the male. In this sex the perinæum is not so deep.

Take first ischio-rectal fossa. *Dissection.* — The steps of the dissection are much the same in both sexes, and the same description will serve, generally, for the perinæum of both the male and the female. First, the dissection of the ischio-rectal fossa is to be made; and afterwards the muscles, vessels, and nerves of the posterior half of the perinæal space are to be examined. (See description of the MALE PERINÆUM, p. 445.)

Then examine anterior half of perinæum. Next the skin is to be taken from the anterior half of the perinæal space, as in the male; and the transverse incision in front is to be made at the anterior part of the vulva. The attachments of the superficial fascia are then to be looked to, and the cutaneous vessels and nerves are to be traced beneath it (p. 449.).

Superficial fascia. *Superficial fascia.* — The description of this structure in the male will serve for the like part in the female with these modifications; that in this sex it is less perfect and of less extent, in consequence of the aperture of the vulva; and that it is continued forwards through the labia majora (the representative of the scrotum) to the inguinal region.

Dissection of the muscles. *Dissection.* — The labia and the superficial fascia are to be removed, to follow the sphincter muscle around the opening of the vagina. The two other muscles that are exposed at the same time (transversalis perinæi and erector clitoridis) resemble those in the male.

Sphincter vaginæ. The SPHINCTER VAGINÆ is an orbicular muscle around the orifice of the vagina, and corresponds to the ejaculator urinæ in the male. Origin. Posteriorly it is attached to the central point of the perinæum, where it mixes with the sphincter ani and transversalis muscles; Insertion. and its fibres are directed forwards, some on each side of the vagina, to be *inserted* into the body of the clitoris.

Erector clitoridis. The ERECTOR CLITORIDIS resembles the erector of the penis in the male, though it is much smaller.

Transversalis. The TRANSVERSALIS is similar to the same muscle in the male. The one description will suffice for these parts in both sexes (p. 454.).

To expose triangular *Dissection.*—To see the triangular ligament of the urethra. the erector and the crus clitoridis are to be detached from

the bone, and the outer fibres of the sphincter vaginæ are to be removed. ligament.

The *triangular ligament* transmits the urethra, but is not quite so strongly marked as in the male; its extent is partly interrupted behind by the large aperture of the vagina, (p. 461.). Triangular ligament.

Dissection. — By cutting through the superficial layer of the ligament in the same way as in the male, the deep muscles, with the pudic vessels and nerve and their branches, will be arrived at. Afterwards the trunks of those vessels, and of the pudic nerve, are to be traced backwards. To see muscles of urethra.

The DEEP TRANSVERSE MUSCLE (depressor urethræ, Santorini) has the same origin externally as in the male, and it meets its fellow at the middle line. Santorini described the muscle as passing over, instead of below the urethra; hence the name given to it by its discoverer. Deep transverse muscle.

The CONSTRICTOR MUSCLE of the urethra resembles that of the male in its origin from the pubes, and its disposition around the urethra. Within it is also a circular layer of involuntary fibres of the urethra, as in the other sex. Constrictor urethræ.

The description of the *pudic artery* (p. 458.) will serve for both sexes, except that the branch in the female, corresponding to the artery of the bulb in the male, is furnished to the vagina. The terminal branches are much smaller too in the female. Pudic vessels.

The *pudic nerve* has the same peculiarity as the artery with respect to the branches to the vagina, and the smaller size of the terminal part of the nerve on the clitoris. Pudic nerve.

CHAPTER VIII.

DISSECTION OF THE ABDOMEN.

Section I.

WALL OF THE ABDOMEN.

Directions for the dissection.

The dissector of the abdomen may be reminded that the perinæum is included in the part of the body assigned to him. And he is to keep in mind that he has not only to finish the examination of that region, but to proceed as far as the end of Section III. before the body is turned for the dissection of the back.

Position of the body.

Position. — The body will be sufficiently raised by the blocks placed beneath the thorax and buttocks, according to the directions given in the dissection of the limbs; but the dissector should see that the chest is higher than the pelvis. After the abdomen has been inflated by an aperture through the umbilicus, let the markings on the surface be first attended to.

Appearances on the front of the abdomen.

Surface-marking. — On its anterior aspect, the abdomen is for the most part convex, especially in fat bodies; whilst on the sides, between the ribs and the crista ilii, the surface is somewhat depressed. Along the middle line is a slight groove, corresponding to the linea alba, which presents about its centre the excavation of the umbilicus. Inferiorly the groove ceases a little above the pelvis in the prominence of the pubes; and superiorly it subsides below the ensiform cartilage in a hollow named the epigastric fossa. On each side of the middle line is the projection of the rectus muscle, and this is intersected in young and well-formed bodies by two or three transverse depressions.

Projections of pubes

Underneath the eminence of the pubes the student will be able to recognise with his finger the symphysis pubis, and to trace outwards from it the contiguous pubic crest which leads to the spinous process. If the finger is still carried outwards

to the crest of the innominate bone, it will detect the firm band of Poupart's ligament, and sometimes a few inguinal glands. Rather above and to the outside of the pubes, the opening of the external abdominal ring may be felt, and the prominence of the spermatic cord descending through it to the testicle may be perceived. The internal abdominal ring is still to the outer side, though it cannot, usually, be recognised on the surface by the finger; but its position may be ascertained by taking a point midway between the symphysis pubis and the crest of the innominate bone, and a little above Poupart's ligament. Attached to the front of the symphysis pubis in the male are the penis and the scrotum.

and Poupart's ligament. Abdominal rings.

Dissection.—The incisions requisite to raise the skin from the sides and front of the belly are the following:—One cut is to extend outwards over the side of the chest from the ensiform cartilage to about midway between the sternum and the spine, if this has not been already made by the dissector of the upper limb. A second incision is to be begun in the middle line midway between the umbilicus and the pubes, and to be carried outwards to the iliac crest, and along the crest till it ends opposite the first cut; lastly, the hinder extremities of those two incisions are to be connected along the side of the chest and the belly. The piece of skin thus marked out is to be raised towards the middle line, and the cutaneous vessels and nerves are to be sought in the fat at the undermentioned spots:—

Raise the skin.

Along the side of the abdomen are the lateral cutaneous nerves, five or six in number, which are in a line with the corresponding nerves of the thorax; they give offsets backwards, and are then directed forwards with small cutaneous arteries. On the iliac crest, near the front, is the branch from the last dorsal nerve; and still farther back on the crest, is the cutaneous branch of the ilio-hypogastric nerve.

Position of cutaneous nerves, on the side:

Near the middle line the small anterior cutaneous nerves will be found; these are uncertain in number and size, and are directed outwards in the integuments.

in front.

The piece of skin that covers the lower part of the abdomen or the groin is next to be thrown downwards, on both sides, by means of an incision along the middle line to the root of the penis. After its reflection, the cutaneous vessels

Take the skin from the groin.

and nerves are to be dissected on the right side, and the superficial fascia on the left.

Seek vessels and nerves in right groin.

To make the necessary dissection on the right side, all the fascia that is superficial to the vessels is to be raised in the same manner as the piece of the skin. The vessels that will then appear are the superficial pudic on the inside, the superficial epigastric in the centre, and there may be an offset of the superficial circumflex iliac artery on the outside. Some inguinal glands are seen along the line of the reflected fascia. Two cutaneous nerves are to be sought; one, the ilio-inguinal, comes out through the abdominal ring, and descends to the thigh; the other, ilio-hypogastric, appears in the superficial fascia above, and rather outside the abdominal ring.

Separate superficial fascia into layers in left groin.

In the dissection of the fascia, on the left side, two strata or layers are to be made out, one above and one beneath the vessels. The layer that is superficial to the vessels is to be raised by means of one transverse cut, not much above Poupart's ligament, from the front of the iliac crest to the middle line, and another along the middle line to the pubes: the position of the subjacent vessels marks the depth of this layer; and when these are reached, a flap of the fascia like that of the skin, is to be thrown down towards the thigh. To define the thinner under stratum, cut it across in the same manner as the other layer, and then detach it with the vessels on it from the tendon of the external oblique muscle. This stratum, like the preceding, is to be traced around the cord to the scrotum; and as the student follows it downwards, he will find it connected with Poupart's ligament, and inseparably joined with the fascia lata close below that structure.

Superficial fascia is divided into two layers.

The *superficial fascia* is a single layer over the greater part of the abdomen, and lies between the skin and the special fascia investing the muscles; but in the groin it is divided into a subcutaneous and a deeper layer by the vessels and the glands.

The subcutaneous layer contains fat,

a. The *subcutaneous layer* contains the fat, and therefore varies in appearance and thickness in different bodies; for it is sometimes divisible into several strata, whilst at others it is very thin and somewhat membranous near the thigh. This layer is continuous with the cutaneous fatty covering

of the thigh, and with that of the rest of the abdomen ; and if it is traced to the limb, it is found to be separated from Poupart's ligament beneath, by the superficial vessels and glands. Internally it is continued to the penis and the scrotum, where it loses its adipose tissue ; and after investing the testicle, the layer is prolonged to the superficial fascia of the perinæum. except in the penis and scrotum.

b. The *deeper layer* of the superficial fascia (aponeurosis of the fascia lata, Scarpa) is thinner and more membranous than the other, and is closely united to the tendon of the external oblique by fibrous bands, especially towards the linea alba. Like the subcutaneous part of the fascia, this layer is continued upwards on the abdomen, and inwards to the penis and the scrotum: in this last part it becomes very thin, and, having passed through the scrotum, reaches the perinæum, where it has attachments to the subjacent parts as before specified (p. 450.). Towards the top of the limb it extends only a very short distance, and ends a little below Poupart's ligament by joining the fascia lata across the front of the thigh; as it passes over the ligament it is closely joined to that band by a thin membrane. Deeper layer is thin and membranous; Special characters and disposition, and ends on fascia lata.

Should urine be effused from rupture of the urethra, it will be directed through the scrotum, by reason of the attachments of the superficial fascia in the perinæum, and then upwards along the spermatic cords to the abdomen. From the disposition of the deep layer across the thigh, it is evident that the fluid cannot pass down the limb, whilst its progress over the front of the abdomen is uninterrupted. Attachments determine course of effused urine.

In the female the superficial fascia of the groin is separable into two layers, and the disposition of each is nearly the same as in the male ; but the part that is continued to the scrotum in the one sex, enters the labium in the other, in its course to the perinæum. In the female the round ligament of the uterus is lost in the superficial fascia of the groin. Fascia in the female.

Cutaneous Nerves. — The nerves in the superficial fascia are derived chiefly from the trunks of the lower five or six intercostal nerves ; — the lateral cutaneous branches along the side of the belly being offsets from those nerves, whilst the anterior cutaneous branches along the front are the terminal parts of the same trunks. Two cutaneous off- Cutaneous nerves are derived from two sources.

sets from the lumbar plexus, viz. the ilio-hypogastric and ilio inguinal, are present at the lower part of the abdomen.

Lateral cutaneous of the intercostal, The *lateral cutaneous nerves* of the abdomen emerge between the digitations of the external oblique muscle, in a line with the same set of nerves on the thorax; and the lowest are the most posterior. As soon as they appear on

which divide into the surface they divide, with the exception of the last, into an anterior and a posterior branch.

posterior and The *posterior branches* are of small size, and are directed backwards to the integuments over the latissimus dorsi muscle.

anterior branch. The *anterior branches* run forwards in the superficial fascia nearly to the edge of the rectus muscle, and supply the integuments on the side of the belly; they furnish offsets to the digitations of the external oblique muscle.

Last dorsal nerve. The lateral cutaneous branch of the *last dorsal nerve* is larger than the rest, and does not divide like the others. After piercing the fibres of the external oblique muscle, it is directed over the iliac crest to the surface of the gluteal region.

Anterior cutaneous nerves of intercostal. The *anterior cutaneous nerves* of the abdomen reach the surface by piercing the sheath of the rectus: in the integuments they turn outwards towards the lateral cutaneous nerves. The number, and the place of exit of these small nerves from the abdominal wall, are very uncertain.

Ilio-hypogastric of lumbar plexus. The *ilio-hypogastric nerve* is distributed on the surface by two pieces: one lies over the crista ilii (iliac branch), the other ramifies on the lower part of the abdomen (hypogastric branch).

Iliac branch. The *iliac branch* is close to the crest of the innominate bone behind the last dorsal nerve, and enters the integument of the gluteal region: its size and its position on the bone are dependent upon the development and the situation of the offset of the last dorsal nerve.

Hypogastric branch. The *hypogastric branch* pierces the aponeurosis of the external oblique muscle above the external abdominal ring, and is distributed, as the name expresses, to the integument of the lower region of the abdominal parietes.

Ilio-inguinal nerve of the plexus. The *ilio-inguinal nerve* becomes cutaneous through the external abdominal ring, and having perforated the deeper layer of the superficial fascia, descends to the scrotum and the upper and inner part of the thigh.

Vessels from two sources. CUTANEOUS VESSELS.— Some cutaneous vessels are found with both sets of nerves on the abdomen: with the lateral

cutaneous nerves are branches from the intercostal arteries, and with the anterior cutaneous are offsets from the internal mammary and epigastric vessels. In the groin are three small superficial branches of the femoral artery, viz. pudic, epigastric, and circumflex iliac: these last are dissected on the right side.

The *lateral cutaneous arteries* have the same anatomy as the nerves they accompany. They are directed towards the front of the abdomen, and end about the outer edge of the rectus muscle. Both lateral

The *anterior cutaneous* vessels are irregular in number and in position, like the nerves. After piercing the sheath of the rectus, they run outwards with the nerves towards the other set of branches. and anterior cutaneous.

Branches of the femoral artery. — Three cutaneous offsets ascend from the thigh between the layers of the superficial fascia, and ramify in the integuments of the genital organs, and in those of the lower part of the abdomen. The greater portion of these vessels appears in the dissection of the thigh. From femoral artery three branches.

The *external pudic branch* (superficial) crosses the spermatic cord, to which it gives offsets, and ends in the integuments of the under part of the penis. External pudic.

The *superficial epigastric branch* ascends over Poupart's ligament, near the centre, and is distributed in the superficial fascia nearly as high as the umbilicus. Its size varies very much. Superficial epigastric.

The *circumflex iliac branch* lies usually below the level of the iliac crest, and sends only a few offsets upwards to the abdomen. Circumflex iliac.

Small *veins* accompany the arteries, and join the internal saphenous vein in the thigh. Veins.

The *glands of the groin* are three or four in number, and lie over the line of Poupart's ligament. They are placed between the strata of the superficial fascia, and receive the lymphatics from the abdomen, from the upper and outer part of the thigh, and from the superficial parts of the genital organs. Their efferent ducts pass downwards to the saphenous opening in the thigh to enter the abdomen. Inguinal glands. Ducts enter thigh.

Dissection. — After the examination of the superficial fascia with its vessels and nerves on the abdomen, the student may make the dissection of the cutaneous coverings of the penis and scrotum. The skin may be divided along Dissection of coverings of penis.

the dorsum of the penis, and thrown to each side; and the skin of the scrotum is then to be reflected by means of a vertical incision on the left side.

Tegumentary covering of penis

Cutaneous coverings of the penis and scrotum.—The penis is attached to the front of the pubes by a suspensory ligament, and is provided with a tegumentary covering with vessels and nerves.

is thin, and without fat;

On *the penis* the tegumentary covering is continuous with that of the abdomen, but the superficial fascia loses the fat that it possesses in most other parts of the body, and acquires special characters.—Around the end of the penis it forms the loose sheath of the prepuce in the following way:—when the skin has reached the extremity, it is reflected backwards as far as to the base of the glans, constituting thus the double layer of the prepuce; it is afterwards continued over the glans, and joins the mucous membrane of the urethra at the orifice on the surface. At the under part of the glans, and behind the aperture of the urethra, the integument forms a small triangular fold, *frænum præputii.* Where the integument covers the glans it is very thin, assuming in some cases the character of a mucous membrane; and behind the glans are some sebaceous follicles—*glandulæ odoriferæ.*

forms prepuce

and frænum.

Sebaceous glands.

Teguments in scrotum.

In the scrotum.—The superficial fascia becomes thin, and of a reddish colour. If it is cut through, the student will perceive that the prolongation sent around the cord on one side, does not communicate with that on the other side; and that the two pouches come in contact in the middle line, and form the septum scroti.

Muscular nature of fascia.

The superficial fascia in the scrotum and penis, and in the front of the perinæum contains involuntary muscular fibres, to which the corrugation of the skin is owing. This contractile structure is named the *tunica dartos.*

Dissection of vessels and nerves.

Dissection.—By removing the superficial fascia from the root of the penis and the front of the symphysis pubis, the suspensory ligament will be defined. And the dorsal arteries, nerves, and vein of the penis, which are seen in the preceding step, are to be followed forwards in the superficial fascia.

Suspensory ligament of penis. Attachments.

The *suspensory ligament of the penis* is a rather deep band of fibrous tissue, of a triangular form, which is attached by its apex to the front of the symphysis pubis near the lower part. Widening as it descends, the ligament divides

into two pieces, which are fixed to the upper surface of the body of the penis, and are prolonged on it for some distance. In the interval between the two pieces or layers are the dorsal vessels and nerves of the penis. Contains vessels and nerves.

Dorsal vessels and nerves. — The arteries and nerves on the dorsum of the penis, are the terminal parts of the pudic trunks of both sides. The vein corresponding to the arteries enters the front of the pelvis through the triangular perinæal ligament. Source of vessels and nerves.

The *dorsal artery*, one on each side, appears between the layers of the suspensory ligament, and extends forwards to the glans, where it ends in many branches for that structure: in its course the artery supplies the integuments and body of the penis. It may be derived from the *accessory pudic* (p. 459.). Dorsal artery of penis, a branch of pudic. Peculiarities.

The *dorsal vein* is a single trunk, and commences by numerous branches from the prepuce and the glans penis. The course of the vein is backwards by the side of the artery, between the layers of the suspensory ligament, and then through the triangular ligament of the urethra, to join the prostatic plexus of veins. In its extent along the penis the vein receives branches from the erectile structures of that body. Dorsal vein ends in prostatic plexus.

Each *dorsal nerve* takes the same course as the artery to the glans penis, and ends like it in numerous branches to that part. It furnishes a large branch to the corpus cavernosum penis, and other offsets to the integuments of the dorsum, the sides, and the prepuce of the penis. Dorsal nerve of pudic.

In the female these vessels are much smaller than in the male; they occupy the upper surface of the clitoris, as in the other sex. Vessels on clitoris.

Dissection. — The surface of the external muscle of the abdominal wall is next to be freed from fascia on both sides of the body. It is not advisable to begin cleaning this muscle in front, because there it has only a thin aponeurosis, which is readily removed with the fat: behind, however, the muscle is thick and fleshy, and cannot well be injured. Whilst beginning the dissection at the posterior part, the student is to carry the knife obliquely upwards and downwards in the direction of the fibres. The thin aponeurosis before referred to is in front of a line extended upwards from the anterior part of the iliac crest; and as the dissector approaches that spot, he must be more careful not to injure it, especially at the upper part where it lies on the margin of the ribs. To expose external oblique muscle.

To define abdominal ring. On the right side, the margin of the external abdominal ring may be defined to show the cord passing through it; and on the left side, a thin fascia (intercolumnar), which is connected with the margin of that opening, is to be preserved. Lastly, the dissector should make evident the free margin of the external oblique muscle between the last rib and the crest of the ilium.

On side three flat muscles, and their aponeuroses incase three vertical ones. *Muscles of the abdominal wall.*—On the side of the abdomen are three large flat muscles, which are named from their position to one another, and from the direction of their fibres. The most superficial muscle is the external oblique, the next one the internal oblique, and the last is the transversalis. Along the middle line the muscles have a vertical direction. In front are the rectus and pyramidalis, and behind the quadratus lumborum; these are incased by sheaths derived from the aponeuroses of the lateral muscles.

External oblique muscle is first. Origin from ribs. The EXTERNAL OBLIQUE MUSCLE is fleshy on the side, and aponeurotic on the fore part of the abdomen. It *arises* by fleshy points or digitations from the eight lower ribs; the highest five pieces, which are attached to the outer surface and the borders of the ribs, alternate with similar parts of the serratus magnus; and the lowest three, connected with the costal margins, interdigitate with the processes of origin of the latissimus dorsi muscle. From the attachment to the ribs, the fibres are directed over the side of the abdomen in the following manner:—the lower fibres descend almost vertically to be *inserted* into the anterior half or more of the iliac crest, at the outer margin; whilst the upper and middle fibres are continued forwards, the one set horizontally, the other obliquely, to the aponeurosis on the front of the belly. Insertion into pelvis and linea alba.

Aponeurosis of the muscle covers front of the belly. The *aponeurosis* of the muscle occupies the anterior part of the abdomen, in front of a line from the eighth rib to the crista ilii, and is rather narrower about the centre, than either above or below. Along the middle line of the body this expansion ends in the linea alba,—the common point of union of the aponeuroses of opposite sides. Above, it is thin, and is continued on the rectus muscle to the pectoralis major and the ribs. Below, the fibres of the aponeurosis are stronger and more separate than above, and are directed obliquely downwards and inwards to the pelvis: some of Disposition above and below.

them are fixed to the front of the pubes; whilst the rest are collected into a firm band between the pubes and the iliac crest, which is named Poupart's ligament.

Connections. — The muscle is subcutaneous. Its posterior border is usually free between the last rib and the iliac crest, but it is commonly overlaid by the edge of the latissimus dorsi, except a small part below. Appearing through the aponeurosis, external to the linea alba, is a white line, the linea semilunaris, corresponding to the outer edge of the rectus muscle; and crossing between the two are three or four whitish marks, the lineæ transversæ. Numerous small apertures in the tendon give exit to cutaneous vessels and nerves; and near the pubes is the large opening of the external abdominal ring, which gives passage to the cord in the male, and the round ligament in the female.

Connections. Lines on the aponeurosis. Apertures in it. Abdominal ring.

Parts of the aponeurosis. — Besides the general arrangement of the aponeurosis over the front of the abdomen, the student is to examine more minutely the linea alba in the middle line; the external abdominal ring with the fascia prolonged from its margin; and the rounded border named Poupart's ligament.

Objects on the aponeurosis.

Linea alba. — This is the central line of union of the aponeuroses of opposite sides on the front of the abdomen. It extends from the xiphoid cartilage to the pubes, and serves as a ligament between those parts. Its breadth is wider above than below, and it is perforated here and there by small apertures, that allow masses of fat to protrude in some bodies. A little below the centre is the umbilicus; this projects now beyond the surface, though before the skin was removed there was a hollow corresponding to it; through it a piece of intestine may protrude from the abdomen.

In the linea alba the aponeuroses are united. In its middle is umbilicus.

External abdominal ring. — This opening may be said to be an interval between the fibres of the aponeurosis as these diverge, near the pubes, to their attachment to two points of bone at a little distance from one another. It is somewhat triangular in form, with the base at the crest of the pubes, and the apex pointing upwards and outwards. The long measurement of the aperture is about an inch, and the transverse about half an inch. Its margins are named pillars, and differ in strength: — the inner one is thin and straight, and is attached below to the front of the symphysis pubis,

External abdominal ring. Form and situation. Size. Inner side or pillar.

where it crosses the corresponding piece of the opposite side —that of the right muscle being superficial. The outer margin is the strongest, and is not straight like the inner, but is bent around the spermatic cord, so as to form a kind of groove for it. This margin is continuous with Poupart's ligament, and is attached below to the pubic spine or tuberosity. A thin membrane (intercolumnar or spermatic fascia) obscures the sides of the opening, and is derived from some intermarginal or intercolumnar fibres on the surface of the aponeurosis. The ring gives passage in the male to the spermatic cord, and in the female to the round ligament; in each case the transmitted part lies on the outer or lower margin or pillar as it passes through, and obtains a covering from the intercolumnar fibres. Through the same aperture the inguinal hernia protrudes from the wall of the abdomen.

Outer margin.

A fascia prolonged from the opening.

The cord in male,

and hernial protrusion pass through.

The *intercolumnar fibres* form a layer over the aponeurosis, and bind together its parallel fibres, so as to construct a resisting membrane. Inferiorly it is strongest, and there a bundle of the fibres is connected with the outer third of Poupart's ligament, and is extended back to the crista ilii. At the external abdominal ring they stretch from side to side (hence the origin of their name), and, becoming stronger and aggregated together, close the upper part of that opening. Moreover they are prolonged on the cord from the margin of the ring, and give rise to the membrane named *intercolumnar fascia.* On the left side, where the fascia is entire, this thin covering will be manifest on the surface of the cord, or on the round ligament in the female.

Intercolumnar fibres.

Attachment inferiorly.

They cross upper part of ring,

and produce the thin intercolumnar fascia.

Dissection.— To see the attachments and connections of Poupart's ligament, it will be necessary to reflect, on both sides of the body, the lower part of the aponeurosis towards the thigh. For this purpose an incision is to be carried through the aponeurosis from the front of the iliac crest nearly to the linea alba. The aponeurosis is to be detached from the subjacent parts with the handle of the scalpel; and when it cannot be separated farther from the tendons beneath, near the middle line, it is to be cut in the direction of a vertical line to the symphysis pubis. After the triangular piece of the aponeurosis has been thrown towards the thigh, the cord is to be dislodged from the surface of the ligament, to see the insertion of this band into the pubes,

To see insertion of Poupart's ligament.

Throw down piece of external oblique.

and to lay bare the fibres which ascend therefrom to the linea alba with the name of triangular ligament.

Poupart's ligament is the lower border of the aponeurosis, which intervenes between the front of the crista ilii and the pubes. Externally it is round and cord-like, and is attached to the anterior superior iliac spine; but internally it widens as it approaches the pubes, and is inserted into the pubic spine, as well as into the pectineal line of the hip bone for about three quarters of an inch, forming thus a triangular-looking piece, with its base directed outwards, which is named *Gimbernat's ligament.* (See the DISSECTION OF THE THIGH.) The line of Poupart's ligament is not straight between its outer and inner attachments, but is curved downwards to the thigh, and retains this position as long as the fascia lata remains uncut. Its outer half is oblique, and is firmly united with the subjacent iliac fascia; along the line of union of the two, other lateral muscles of the abdominal wall are attached. Its inner half is placed over the vessels passing from the abdomen to the thigh, and beneath the spermatic cord.

Poupart's ligament. Situation. Outer and inner attachments: last forms Gimbernat's ligament. Its direction, and parts in contact with it.

Triangular ligament.— From the insertion of Poupart's ligament into the pectineal line, some fibres are directed upwards and inwards beneath the inner pillar of the ring to the linea alba, where they blend with the other tendons. As the fibres ascend, they diverge and form a thin band, to which the name *triangular ligament* has been applied.

Triangular ligament.

Dissection.— The remnant of the external oblique is now to be taken away, on both sides of the body, to see the parts that it covers. The muscle may be detached by carrying the scalpel through the digitations on the ribs back to the free border, and then through the attachment to the crista ilii. The muscle may be thrown forwards as far as it is practicable, after the nerves that cross the iliac crest are dissected out; but in raising it care must be taken not to detach the rectus muscle from the ribs above, nor to cut through the tendon of the internal oblique near the same part. By the removal of the fatty tissue the underlying internal oblique muscle, with some nerves on its surface below, will be cleaned: at the lower border of the internal oblique the cremaster muscle is to be dissected out on the cord.

Dissection to expose internal oblique.

Parts covered by external oblique.

Parts covered by external oblique.—Beneath the external, is the internal oblique muscle, with the ribs and the intercostal muscles. At the lower part of the abdomen the outer muscle conceals the cord, and the branches of nerves from the lumbar plexus contained in the abdominal wall. The aponeurosis of the external oblique is placed in front of the sheath of the rectus.

Internal oblique muscle.

The INTERNAL OBLIQUE MUSCLE is fleshy below and aponeurotic above, just the reverse of the preceding muscle; and its fibres (except the lowest) ascend across the direction

Origin from pelvis.

of those of the external oblique. The muscle *arises* along the outer half of Poupart's ligament, along the anterior two thirds of the crest of the hip bone, and from the tendon of the transversalis muscle (fascia lumborum) in the interval

Insertion into the ribs and linea alba,

between that bone and the last rib. The fibres diverge on the abdomen to their destination:—The posterior fleshy fibres ascend to be *inserted* into the cartilages of the lower three ribs, and join the internal intercostal muscles of the

except lowest fibres.

lowest two spaces. The anterior or lower fibres arch downwards and inwards (from Poupart's ligament) over the spermatic cord, and end in the aponeurosis near the pubes. The intervening fibres pass obliquely to the aponeurosis.

Aponeurosis of the muscle.

The *aponeurosis* of the muscle covers the fore part of the abdomen from the pelvis to the chest, and blends with its fellow along the middle line. Over the greater part of the

Divides to incase rectus.

front of the abdomen the aponeurosis incases the rectus; but midway between the umbilicus and the pubes it is undivided,

Attachments to chest,

and lies in front of that muscle. Superiorly it is attached to the thorax after the following manner: the stratum that is superficial to the rectus is fixed to the ninth rib, and blends with the aponeurosis of the external oblique; and the stratum beneath the muscle joins the cartilages of the

and inferiorly.

eighth and seventh ribs and the ensiform cartilage. Inferiorly its fibres become more distinct and separate, as in the external oblique, and are inserted into the front of the pubes, and into the pectineal line for half an inch, behind the attachment of Poupart's ligament.

Parts in contact with oblique.

Connections.—The internal is covered by the external oblique muscle. It is attached on all sides, except between Poupart's ligament and the pubes where it arches over the cord, and has the cremaster muscle contiguous to it. The

parts that are covered by the internal oblique cannot be seen till the muscle is reflected.

The CREMASTER MUSCLE is a fasciculus of fibres, which lies along the lower border of the internal oblique muscle, and is so named from suspending the testicle. The muscle has attachments above, at the inner and outer sides, similar to those of the internal oblique. Externally it is fleshy, and is attached to Poupart's ligament below, and in part beneath the internal oblique, with which some of the fibres are connected, and it may also join the transversalis; but internally it is small and pointed, and is fixed, chiefly by tendon, to the front of the pubes and the sheath of the rectus. Between those two points the fibres descend on the front and sides of the cord, forming loops with the convexity downwards; and the lowest loops are connected with the tunica vaginalis testis. The muscular fibres are united by connective tissue so as to give rise to a covering on the front of the cord, which is named *fascia cremasterica*. Occasionally the fibres may be behind as well as on the sides and front of the cord.

Cremaster muscle.

Attachments: external fleshy, internal tendinous;

forms loops over the cord,

giving rise to cremasteric fascia.

Dissection. — On the left side of the body the student is not to make any further dissection of the abdominal wall; but the parts that have been reflected in the groin should be carefully replaced, until the examination of those parts in connection with hernia is returned to.

In left groin replace parts.

On the right side the dissection is to be carried deeper by the reflection of the internal oblique and the cremaster. The last muscle may be reflected from the cord by means of a longitudinal incision. To raise the internal oblique, it will be necessary to cut it through near the ribs, and near the crest of the hip bone, and then to connect those incisions behind: its depth will be indicated by a fatty layer between it and the transversalis. In raising the muscle towards the edge of the rectus, the student must separate with great care the lower fibres from those of the transversalis, with which they are often conjoined; and must dissect out the trunks of the intercostal nerves and arteries, the last dorsal nerve, and the two branches of the lumbar plexus (ilio-hypogastric and ilio-inguinal) near the front of the crest of the hip-bone; the offsets of the intercostals that enter the muscle must be cut.

On right side of abdomen reflect cremaster and internal oblique.

Parts covered by internal oblique.

Parts covered by the oblique. — The internal oblique conceals the transversalis muscle, and the vessels and nerves between the two. Near Poupart's ligament it lies on the spermatic cord and the fascia transversalis. The rectus muscle is concealed by its aponeurosis, and partly incased by it.

Transversalis muscle.

The TRANSVERSALIS MUSCLE forms the third stratum in the wall of the abdomen. Like the former muscle, it is attached on all sides except where the spermatic cord lies, and takes origin from the pelvis, the chest, and the lumbar vertebræ: it has both an anterior and a posterior aponeurosis. At the pelvis it rises along the outer third of Poupart's ligament, and the anterior two thirds of the iliac crest. At the chest it takes origin from the lower six ribs, viz. by tendon from the lowest two, and by fleshy processes from the under surface of the cartilages of the following four: and it is connected also with the lumbar vertebræ between the chest and the pelvis, by means of the posterior aponeurosis of the fascia lumborum. Most of the fibres are directed transversely to the aponeurosis in front; but the lower arch downwards above the spot at which the cord leaves the abdomen, and end in the aponeurosis internal to that aperture.

Origin from chest, loins, and pelvis.

Fibres end in aponeurosis.

Lowest arch down to pubes.

The aponeurosis passes beneath rectus to linea alba, except inferiorly.

Its *aponeurosis* is widest inferiorly, as in the most external muscle. It is continued to the linea alba beneath the rectus, except midway between the umbilicus and the pubes, where it passes in front of that muscle to reach the middle line. Its attachment below to the pelvis is nearly the same as that of the aponeurosis of the internal oblique, for it is fixed to the front of the pubes, and to the pectineal line for about an inch, but beneath the insertion of the oblique muscle. At the insertion into the pubes, some of the fibres are spent on the transversalis fascia, and are connected with a thickened band of that fascia beneath Poupart's ligament, which is called the deep crural arch.

Fibres to transversalis fascia.

At pelvis joins that of internal oblique in conjoined tendon.

Conjoined tendon. — The aponeuroses of the internal oblique and transversalis muscles are united more or less near their attachment to the bone, and thus give origin to the conjoined tendon; but it may be observed that the tendon of the oblique muscle seldom extends more than half an inch along the pectineal line, whilst that of the transversalis

reaches an inch along the bony ridge, and forms the greater part of the conjoined tendon.

The *posterior aponeurosis* of the transversalis, or the fascia lumborum, is described in the dissection of the back (p. 409.). Posterior aponeurosis.

Connections of the muscle. — Superficial to the transversalis are the two muscles before examined; and beneath it is the thin fascia transversalis, which separates it from the peritoneum. Its fleshy attachments to the ribs digitate with like processes of the diaphragm. The lower border is fleshy in the outer, but tendinous in the inner half, and is arched above the internal abdominal ring. Occasionally the muscle arises from Poupart's ligament as low down as the internal oblique, with which, and with the cremaster, it is then inseparably united. Connections of transversalis muscle.

Dissection. — To remove the aponeurotic layer from the rectus muscle, make a longitudinal incision through the tendinous sheath, and turn it to each side. In this proceeding a small muscle, the pyramidalis, will be exposed near the pubes. The dissector should take care of the nerves entering the outer border of the rectus. To expose rectus and pyramidalis.

The RECTUS MUSCLE extends along the front of the abdomen from the pelvis to the chest. The muscle is narrowest inferiorly, and is attached to the pubes by two tendinous processes;—one, internal to the other and the smallest, arises from the front of the symphysis, where it joins that of the opposite side; and the external process is attached to the pubic crest. Becoming wider towards the thorax, the muscle is inserted by three large fleshy processes into the cartilages of the last three true ribs; and the highest slip, which is also external, is attached to both the bone and the cartilage of its rib. The muscle is contained in an aponeurotic sheath, except above and below; and its fibres are interrupted at intervals by irregular tendinous lines, the *inscriptiones tendineæ*. Rectus muscle. Attachments to pubes. Insertion into ribs. Has cross tendons.

Sheath of the rectus. —The aponeurotic casing of the rectus muscle is derived from the splitting of the aponeurosis of the internal oblique, one of the pieces passing before, the other under the muscle; and the two unite at the inner border. Inseparably blended with the stratum in front of the muscle is the aponeurosis of the external oblique; and Its sheath, how formed.

joined in a similar manner with that behind, is the aponeurosis of the transversalis. The sheath is deficient behind, both above and below. Above, the muscle rests on the ribs, without the intervention of the sheath which is fixed to the margin of the thorax. Below, midway between the umbilicus and the pubes, the internal oblique ceases to incase the rectus, and passes altogether in front of it with the other aponeuroses; at the spot where the sheath is wanting inferiorly is a white, and sometimes well-defined margin (the fold of Douglas), when the outer edge of the muscle is raised. Where the sheath is deficient, the rectus is in contact with the fascia transversalis.

Its extent.

Deficient inferiorly.

The *lineæ transversæ* are the tendinous intersections that cross the surface of the rectus. There are usually three of these lines at the following spots: one is opposite the umbilicus, another at the ensiform cartilage, and the third midway between the other two. If there is a greater number, the additional one will be below the umbilicus. These markings seldom extend the whole breadth or depth of the muscular fibres, more particularly above and below.

Lineæ transversæ are three or more. Situation.

Linea semilunaris. — This line which was before alluded to with the aponeurosis of the external oblique muscle, corresponds with the outer edge of the rectus, and reaches from the eighth rib to the outer part of the pubic crest of the hip bone: it marks above the line of division of the aponeurosis of the internal oblique muscle.

Linea semilunaris is at edge of rectus.

The PYRAMIDALIS MUSCLE is triangular in form, and is placed in front of the rectus near the pelvis. The muscle *arises* by its base from the front of the pubes, and is *inserted* by tendon into the linea alba, about midway between the umbilicus and the pubes. This small muscle is often absent.

Pyramidalis muscle. Attachment to pubes and linea alba.

NERVES.—Between the internal oblique and transversalis muscles are the intercostal nerves; and near the pelvis are the two branches of the lumbar plexus. Some arteries accompany the intercostal nerves, but they will be referred to with the vessels of the abdominal wall (p. 486.).

Nerves in wall of abdomen.

a. The lower six *intercostal nerves* (p. 395.) enter the wall of the abdomen at the anterior part of the intercostal spaces. Placed between the two deepest lateral muscles, the nerves are directed forwards to the edge of the rectus, and then through this muscle to the surface along the front of

Intercostal nerves are between oblique and

the abdomen. About midway between the spine and the linea alba, the nerves furnish cutaneous branches to the side of the abdomen (lateral cutaneous, p. 468.); and whilst between the abdominal muscles they supply muscular branches, as well as offsets of communication with one another. A greater part of the lower than of the upper nerves is visible, because of the shortness of the inferior intercostal spaces.

trans-versalis.

Offsets.

The *last dorsal nerve* is placed below the twelfth rib, and therefore not in an intercostal space, but otherwise it has connections and a distribution like the preceding. As it extends forwards to the rectus it communicates sometimes with the ilio-hypogastric nerve: its lateral cutaneous branch perforates the two oblique muscles.

Last dorsal nerve.

b. Two *branches of the lumbar plexus*, viz. ilio-hypogastric and ilio-inguinal, are contained for a certain distance between the muscles of the wall of the abdomen, as they course forwards to the surface of the body.

Branches of lumbar plexus.

The *ilio-hypogastric nerve* perforates the back of the transversalis muscle, near the iliac crest, and gives off the *iliac* or lateral cutaneous branch. The nerve then turns forwards above the hip bone, and is connected with its companion (ilio-inguinal), near the front of that bone. Perforating then the fleshy part of the internal oblique, and the aponeurosis of the external oblique near the linea alba, the nerve becomes cutaneous as before seen (p. 468.). The *iliac branch* pierces both oblique muscles, close to the crest of the bone, to reach the gluteal region.

Ilio-hypogastric lies near iliac crest.

Furnishes cutaneous branch.

The *ilio-inguinal nerve* perforates the transversalis near the front of the iliac crest, where it is connected with the preceding. The nerve afterwards pierces the internal oblique, to which it supplies branches, and coursing over that muscle, reaches the surface of the thigh through the external abdominal ring (p. 468.).

Ilio-inguinal issues through ring.

This nerve may be so small as to end by joining the ilio-hypogastric branch. In such cases the ilio-hypogastric furnishes an offset that takes the usual place of, and corresponds in distribution with the ilio-inguinal nerve.

May be very small.

Dissection. — For the purpose of seeing the transversalis fascia, it will be necessary to raise, on the right side, the lower part of the transversalis muscle by two incisions; —

Dissection of transversalis fascia.

one of these is to be carried through the fibres that are attached to Poupart's ligament; the other, across the muscle from the front of the hip bone to the margin of the rectus. With a little care the muscle may be separated easily from the thin fascia beneath.

Fascia transversalis is best marked in the groin.

The *fascia transversalis* is a thin fibrous layer between the transversalis muscle and the peritoneum, which has been so named by Sir A. Cooper. In the groin or inguinal region where it is unsupported by muscles, the fascia is considerably stronger than elsewhere, and is joined by fibres of the aponeurosis of the transversalis muscle; but above that region it gradually decreases in strength, until at the thorax it becomes an unimportant thin membrane. In the part of the fascia now laid bare is an opening — the internal abdominal ring, which gives passage to the spermatic cord, or the round ligament, according to the sex. On the inner side of that opening the fascia is thinner than on the outer side, and is fixed internally into the pubes and the pectineal line of the hip bone, behind the conjoined tendon with which it is united. When traced down to Poupart's ligament, this membrane will be found joined to the posterior margin of that band along the outer half; but only slightly connected with the ligament along the inner half, as it is directed down to the thigh in front of the bloodvessels, and forms the anterior part of a loose sheath (crural) around the vessels.

Near Poupart's ligament is the internal abdominal ring.

Is partly joined to Poupart's ligament, and partly not.

Situation of abdominal ring.

Abdominal ring. —The opening of the internal abdominal ring is situate midway between the symphysis pubis and the anterior superior iliac spine, and half an inch above Poupart's ligament. From its margin a thin tubular prolongation of the fascia is continued around the cord.

Dissection to trace process on cord.

Dissection. — The prolongation of the fascia tranversalis on the cord may be traced by cutting the fascia horizontally above the opening of the ring, and then longitudinally over the cord. With the handle of the scalpel the thin membrane may be reflected to each side from the subperitoneal fat. After the subperitoneal fat has been seen, let it be reflected to trace the remains of the tube of peritoneum along the cord.

Subperitoneal fat in the groin.

The *subperitoneal fat* forms a layer between the fascia transversalis and the peritoneum. Its depth varies much in different bodies, but the stratum is thicker at the lower part

of the abdomen than elsewhere. A prolongation is sent from it along the cord. This structure will be more specially examined in the dissection of the wall of the abdomen from the inside.

The *peritoneum*, or the serous sac of the abdominal cavity, projects slightly forwards opposite the abdominal ring. Connected with it, at that spot, is a fibrous process, the remains of a prolongation from it to the testis in the fetus, which extends a certain distance along the front of the cord; but there is great variety in its condition. In one body the process can be followed only a very short distance, whilst in another it may be traced as a fine band to the tunica vaginalis of the testis. In other instances it may be sacculated at intervals, or, in rarer cases, it may form only one large bag in front in the cord: these last two conditions can be explained by an arrest in the changes usually taking place in the piece of the peritoneum that is prolonged to the testis, for should it be closed only opposite the abdominal ring, one large pouch or sac would be left in front of the cord, and should it be obliterated here and there, the sacculated state would result. Lastly, as a rare condition, the tube of peritoneum may be found unobliterated, so that a coil of intestine could descend in it from the abdomen.

Peritoneum of the groin is prolonged on the cord; piece may be impervious, or sacculated, or open.

In the female the tube of peritoneum sometimes remains pervious for a short distance in front of the round ligament; the unobliterated passage is named the canal of Nuck.

In female, partly open.

The SPERMATIC CORD extends from the internal abdominal ring to the testis, and consists of the vessels and the efferent duct of that gland united together by coverings from the structures by or through which it passes. In the wall of the abdomen the cord lies obliquely, because its aperture of entrance amongst, is not opposite its aperture of exit from the muscles; but escaped from the abdomen, it descends almost vertically to its destination. As it lies in the passage, which has been named the inguinal canal, it is placed at first (beginning externally) beneath the internal oblique, and rests against the fascia transversalis; but beyond the lower border of the oblique muscle, or nearer the pubes, it rests on the upper surface of Poupart's ligament, and has the aponeurosis of the external oblique between it and the surface of the body, and the conjoined tendon behind it.

Spermatic cord is oblique in the abdomen and vertical beyond. Connections with parts around.

Coverings. Its several coverings are derived from the different strata in the wall of the abdomen, except from the transversalis muscle. Thus, in proceeding from within outwards, the student will find the following layers around the constituents of the cord: — first the subperitoneal fat, then the tube of the fascia transversalis, next the cremaster muscle — continuous with the internal oblique, afterwards the intercolumnar fascia from the external oblique muscle, and lastly the superficial fascia and the skin.

In female round ligament is in place of cord. The *round ligament*, or the suspensory cord of the uterus, occupies the inguinal canal in the female, and ends in the integuments of the groin. Its coverings are similar to those of the spermatic cord, except it wants usually the cremaster.

Dissection. *Dissection.* — The constituents of the cord will be displayed by turning aside the different surrounding layers, and removing the connective tissue. The dissector should trace branches of the genito-crural nerve and epigastric artery into the cremasteric covering.

Constituents of the cord. *Vessels and nerves of the cord.*—In the cord are collected together the spermatic artery and veins that convey the blood to, and take it away from the testis; nerves and lymphatics of the testicle; and the vas deferens or the efferent duct.

Spermatic artery; The *spermatic artery* is a branch of the aorta. It enters the cord through the internal abdominal ring, and descends to the testis, in which it ends: it distributes branches to the vas deferens and the epididymis. In the female, a branch from the *ovarian* artery (spermatic?) enters the round ligament. The *spermatic veins* leave the posterior part of the testicle, and receive branches from the epididymis: ascending in the cord, in front of the vas deferens, they divide and anastomose, and form the *spermatic plexus*.

veins.

Artery and nerve of the coverings of the cord. The *cremasteric covering* of the cord has a separate artery and nerve. The *artery* is derived from the cremasteric branch of the epigastric (p. 487.), and is distributed to the coverings of the cord. The *genital branch* of the genito-crural nerve enters the cord by the internal abdominal ring, and ends in the cremaster muscle. Other filaments to the coverings of the cord come from the ilio-inguinal nerve.

Nerves. The *nerves* of the testicle are derived from the spermatic plexus of the sympathetic in the abdomen; they accompany

the spermatic artery. The *lymphatics* begin in the testis, and ascend along the cord through the internal abdominal ring, to end in the lumbar glands. **Lymphatics.**

The *vas deferens* reaches from the testicle to the urethra, and is placed behind the other constituents of the cord; it will be easily recognised by its resemblance in feel to a piece of whipcord, when it is taken between the finger and the thumb. As it enters the abdomen through the opening in the fascia transversalis (internal ring), it lies on the inner side of the vessels of the testicle; and as it begins its descent to the pelvis, it winds behind the epigastric artery. **Vas deferens. Situation and course.**

Dissection. — A fibrous band below Poupart's ligament, which has been named the deep crural arch, will be found by cutting through the cord near the external ring, and raising it towards the inner abdominal ring: this thin band passes inwards to the pubes, and is to be defined with care. **Dissection of deep arch**

The remaining vessels of the abdominal wall, viz., the epigastric and circumflex iliac, and the ending of the internal mammary artery, are to be next dissected: the epigastric and mammary arteries will be seen, on turning up the outer edge of the rectus, one above and the other below; and the epigastric with its earliest branches may be traced further, by removing the fascia transversalis from it near Poupart's ligament. The circumflex iliac artery lies behind the outer half of Poupart's ligament, and should be pursued along the iliac crest. **and of the vessels.**

Deep crural arch. — Below the level of Poupart's ligament is a thin band of fibres, which lies over the femoral vessels, and has received the name of deep *crural* arch from its position, and resemblance to Poupart's ligament or the superficial crural arch. This fasciculus of fibres beginning externally about the centre of the ligament, is prolonged inwards to the pubes, where it is widened, and is inserted into the pectineal line at the abdominal aspect of the conjoined tendon of the broad muscles of the abdomen.* This **Deep crural arch.**

* Sometimes this structure is a firm distinct band, and is joined, as it would seem, by some of the lower fibres of the aponeurosis of the external oblique. At other times, and this is the most common arrangement, it is only a thickening of the fascia transversalis with fibres added from the tendon of the transversalis muscle. In six bodies, both male

structure is closely connected with the front of the crural sheath, and is arched down on the inner side of that tube to be fixed to the bone.

Vessels in abdominal wall.

VESSELS IN THE WALL OF THE ABDOMEN. — On the side of the abdomen are the intercostal and lumbar arteries, with the intercostal nerves; in the sheath of the rectus are the epigastric and internal mammary vessels; and around the crest of the hip bone is the circumflex iliac branch.

Intercostal arteries.

The *intercostal arteries* issue from the spaces between the ribs and enter the abdominal wall between the transversalis and internal oblique muscles: they extend forwards with the nerves, supplying the contiguous muscles, and anastomose with the internal mammary, epigastric, and lumbar arteries.

Lumbar.

Lumbar artery. — The vessel that accompanies the last dorsal nerve is furnished by the first lumbar artery.

Internal mammary.

The *internal mammary artery.* — The abdominal branch of this vessel (p. 266.) enters the wall of the abdomen beneath the cartilage of the seventh rib. Descending for a short distance in the sheath of the rectus, the vessel enters the substance of that muscle, and anastomoses in it with the epigastric artery.

Musculo-phrenic.

The *musculo-phrenic* part of the same artery passes outwards along the margin of the thorax to the last intercostal space: it appears on the under surface of the diaphragm at the ninth rib, and gives offsets to that muscle and the lower intercostal spaces.

Epigastric artery anastomoses with internal mammary in sheath of rectus.

The *epigastric artery* arises from the external iliac, about a quarter of an inch above Poupart's ligament; it ascends in the sheath of the rectus above the umbilicus, and divides into branches that enter the muscle, and anastomose with the internal mammary. In this course the vessel is first bent inwards, and ascends beneath the fascia transversalis; but it perforates that fascia, and enters the sheath of the rectus over the defined border at the posterior aspect. As it courses to the rectus, the artery passes beneath the cord and on the inner side of the internal abdominal ring; and is directed obliquely inwards across the lower part of the abdomen, where it forms the outer boundary of a triangular space

Connections in wall of abdomen.

and female, which I examined carefully, I found the deep arch to be formed only by a thickening of the fascia transversalis.

close to the edge of the rectus. The *branches* of the artery are numerous but inconsiderable in size; — Branches.

a. The *pubic branch* is a small transverse artery, which runs behind Poupart's ligament to the posterior aspect of the pubes, and anastomoses with a similar branch from the opposite side. Behind the pubes it communicates with a small offset from the obturator artery: the size of this anastomosis varies much, but its situation is internal to the crural ring. Pubic joins obturator by an offset.

b. A *cremasteric branch* is furnished to the coverings of the cord as before mentioned. Cremasteric.

c. *Muscular branches* are given from the outer side of the artery to supply the abdominal wall, and to anastomose with the intercostal arteries. Other branches enter the rectus. Muscular.

d. Some *cutaneous offsets* pierce the rectus, and ramify in the integument with the anterior cutaneous nerves. Cutaneous.

Two *veins* are found with the epigastric artery; these join finally into one, and open into the external iliac vein. Epigastric veins.

Peculiarities. — The *position* of this artery on the trunk of the external iliac may be gradually shifted upwards, from the level of Poupart's ligament, as far as two inches and a half above it; or the origin of the vessel may be below the ligament, it being transferred to the superficial or the deep femoral artery. Peculiarities in origin.

Union with branches. — Frequently the epigastric furnishes the obturator artery to the pelvis; in such cases the small communicating offset, which is ordinarily given to join the obturator, may be supposed to be enlarged. Or the epigastric may arise from the obturator — this having its usual course. May give off obturator.

The *circumflex iliac artery* arises from the outer side of the external iliac, opposite the epigastric, and then courses outwards around the iliac crest, as the name expresses. Circumflex iliac

Having pierced the tube of membrane that surrounds the upper part of the femoral vessels, the artery lies at first below Poupart's ligament, but it passes next beneath the transversalis muscle to the middle of the crest of the hip bone. is in wall of abdomen,

Here the vessel pierces the transversalis, and is continued backwards, between this and the internal oblique, to anastomose with the ilio-lumbar branch of the internal iliac artery. Its *branches* are muscular and anastomotic. and anastomoses with ilio-lumbar.

Near the front of the iliac crest a small branch ascends between the internal oblique and transversalis muscles, supplying them, and anastomoses with the epigastric and lumbar arteries. As the vessel extends backwards it gives lateral offsets, which supply the neigh- Muscular offsets.

bouring muscles, and communicate on the one side with the ilio-lumbar, and on the other with the gluteal artery.

Circumflex vein. The companion *vein* with this artery is formed by the junction of two collateral branches, like the epigastric, and crosses the external iliac artery, nearly an inch above Poupart's ligament, to reach the iliac vein on the inner side.

Section II.

HERNIA OF THE ABDOMEN.

Inguinal hernia. The lower part of the wall of the abdomen, which has been reserved on the left side of the body, should be now dissected for the anatomy of inguinal hernia.

The dissection on the left groin. *Dissection.*—The skin, the superficial fascia, and the aponeurosis of the external oblique having been already reflected in the previous examination of the wall of the abdomen, the necessary dissection of the inguinal region will be completed by reflecting the internal oblique muscle. To raise upwards the muscle, its lower fleshy origin from Poupart's ligament must be detached. For this purpose let one incision be made across the fleshy part of the internal oblique, from the iliac crest towards the linea alba; and after the depth of the muscle has been ascertained by the layer of connective and fatty tissues beneath it, let the lowest fibres be carefully cut through at their origin from Poupart's ligament. By detaching the muscle cautiously, the student will be able to raise it from the subjacent transversalis, so that it may be turned upwards on the abdomen: the separation of the two muscles just mentioned is sometimes difficult in consequence of their fibres being blended together, but a branch of the circumflex iliac artery marks their intermuscular space. The cremaster muscle is then to be divided along the cord, and to be reflected to the sides.

Reflect oblique.

Clean subjacent parts. Let the dissector clean the surface of the transversalis muscle, without displacing its lower arched border, and trace with care the conjoined tendon of the internal oblique and transversalis, to show its exact extent outwards. The fascia transversalis and the spermatic cord should be likewise nicely cleaned. Crossing the interval apparent below the

border of the transversalis muscle, is the epigastric artery, which lies close to the inner side of the internal abdominal ring, but beneath the fascia transversalis: a small piece of the fascia should be cut away to show the vessel on the side of the abdominal ring.

INGUINAL HERNIA.—A protrusion of intestine through the lower part of the abdominal wall above Poupart's ligament,—the part corresponding to the inguinal region, is named an inguinal hernia. The escape of the intestine in this region is predisposed to by the deficiency in the muscular strata, by the passage of the spermatic cord through the abdominal parietes, and by the existence of fossæ on the inner surface of the wall. The gut, in leaving the abdomen, either passes through the internal abdominal ring with the cord, or is projected through the part of the abdominal wall between the epigastric artery and the edge of the rectus muscle. Situation of inguinal hernia. Predisposition naturally. Course it follows.

The hernia of this region is distinguished by names (external and internal), derived from its position to the epigastric artery; and by the terms oblique and direct, from its position in the abdominal wall; so that the hernia that comes through the internal abdominal ring with the cord is called synonymously external and oblique, whilst the hernia between the edge of the rectus and the epigastric artery is named, in like manner, internal and direct. Two kinds, external or oblique; internal or direct.

EXTERNAL OR OBLIQUE INGUINAL HERNIA leaves the abdomen with the spermatic cord, and traversing the inguinal canal, makes its exit from the wall of the abdomen by the external abdominal ring. External or oblique.

Anatomy.—To acquire a knowledge of the anatomy of this hernia it will be necessary to study the space in which it lies (inguinal canal), the apertures by which it enters and leaves the wall of the abdomen (abdominal rings), and the coverings that it receives in its progress to the surface of the body. Anatomy of parts concerned.

The *inguinal canal* is the interval between the flat muscles of the abdominal wall, which contains the spermatic cord in the male, and the round ligament in the female. Its direction is oblique downwards and inwards, being nearly parallel to Poupart's ligament; and its length is about one inch and a half. Superiorly it communicates with the cavity Inguinal canal. Direction. Length. Openings.

of the abdomen by the internal abdominal ring, and inferiorly ends on the surface at the external abdominal ring.

Boundaries next surface. Towards the surface of the body the canal is bounded by the two oblique muscles though unequally: — thus in the outer third of its extent (half an inch) it is formed by both oblique muscles; but at the inner or lower two thirds (one inch) it is bounded in front only by the aponeurosis of the external oblique. Superficial to these muscular parts, or towards the surface, are the skin and fat.

Next the abdominal cavity. Next the cavity of the abdomen the wall of the canal is constructed by the fascia transversalis, and the conjoined tendon of the internal oblique and transversalis in this wise: — the fascia reaches all the distance, like the external oblique; and the conjoined tendon, with the fascia transversalis behind it, extends an inch below along the posterior boundary. Deeper than the fascia are the subperitoneal fat and the peritoneum, corresponding with the skin and superficial fascia on the outer surface. Occasionally the triangular ligament projects far enough outwards behind the external abdominal ring, to take part in the formation of the posterior wall of the canal.

Flooring and roof of the canal. Along the lower part, or the floor, the canal is limited by the union of the fascia transversalis with Poupart's ligament, and by the fibres of the ligament that turn back to the pectineal line; whilst along the upper part its extent is determined only by the apposition of the muscles.

Canal in the female. In the female, the canal has the same length and boundaries, though it is usually somewhat smaller. In that sex it lodges the round ligament.

Internal abdominal ring. Situation. The *internal abdominal ring* is an aperture in the fascia transversalis, which is situate half way between the symphysis pubis and the iliac crest, and half an inch above Poupart's ligament. Upper and inner boundary. Arching above the aperture, and then descending on the inner side, is the lower border of the transversalis muscle; this is fleshy at the outer, but tendinous at the inner half. On the inner side of the opening lies the epigastric artery. Form and margin. It is oval in form, the extremities of the oval being directed upwards and downwards, and the fascia at its outer and lower parts is stronger than at the opposite side. This opening in the fascia transversalis is the inlet to the inguinal canal, and through it the cord, or the round ligament, passes into the wall of the

abdomen. The external hernia leaves likewise the abdomen at the same spot. All the protruding parts receive as a covering the prolongation of the fascia from the margin of the opening. Parts transmitted through it.

The *external abdominal ring* is the outlet of the inguinal canal, and through it the cord, or the inguinal hernia, reaches the surface of the body. This aperture is placed in the aponeurosis of the external oblique muscle, near the crest of the pubes; and from the margin a prolongation is sent on the parts passing through it (see p. 473.). External abdominal ring. Situation.

Course and coverings of the hernia. — A piece of intestine leaving the abdomen with the cord, and continuing with this through the inguinal canal to the surface of the body, will obtain the same coverings as the cord, viz. one from every structure in the lateral part of the wall of the abdomen, except from the transversalis muscle. It receives its investments in this order: — As the intestine is first thrust outwards, it carries before it the peritoneum and the subperitoneal fat, and enters the tube of the fascia transversalis (infundibuliform fascia) that surrounds the cord. Still increasing in size the piece of gut is forced downwards to the lower border of the internal oblique muscle, where it will have the cremasteric fascia or covering applied to it. The intestine is afterwards directed along the front of the cord to the external abdominal ring, and in passing through that opening receives the investment of the intercolumnar or spermatic fascia. Lastly, as the hernia descends to the scrotum, it has the additional coverings of the superficial fascia and the skin. So that in a hernia which has passed the external abdominal ring, the coverings from without inwards are the following: the skin and the superficial fascia, the spermatic and cremasteric fasciæ, the fascia transversalis, the subperitoneal fat, and the peritoneum or sac. These different laminæ become much thickened in a hernia that has existed for some time. Should a piece of intestine remain in the inguinal canal the layers that invest it will depend upon the spot to which it has extended. The intestine, following the course of the cord, has coverings of the peritoneum and fat, fascia transversalis, cremaster, spermatic fascia, superficial fascia, and skin, if it has left the abdominal wall.

Seat of stricture. — The protruded intestine may be constricted in the internal abdominal ring by the neck of the sac, in the inguinal canal by the fleshy internal oblique muscle, or at the external abdominal ring: and the stricture Stricture where situate.

is usually placed at one or another of the rings, though most commonly at the inner. Whilst efforts are being made to force back the piece of protruded intestine, the direction of the canal and the situation of the internal abdominal ring should be borne in mind. Supposing the stricture to be in the neck of the sac, so as to render necessary the opening of the sac and the division of the strictured part from within, the incision should be made directly upwards.

To free it, direction of the incision.

Terms applied to the inguinal hernia from its position.

Designations. — This kind of hernia has other names sometimes applied to it by surgeons, according as it has passed certain points in the wall of the abdomen. If the protrusion remains in the inguinal canal, the term *bubonocele* is applied to the swelling; but if it has extended into the scrotum, the appellation of *scrotal rupture*, or *oscheocele*, is given to it.

Two varieties; from the nature of the peritoneal sacs.

Varieties of the hernia. — There are two varieties of the oblique inguinal hernia, which are distinguished by the condition of the peritoneal covering. For, if the piece of the peritoneum, which accompanies the testicle from the abdomen in the fetus, remains unobliterated, so that the intestine descends in it without protruding any fresh piece of the serous membrane, the hernia is called *congenital:* and should the prolongation of the peritoneum be only partly obliterated, say in the inguinal canal, so that the descending intestine, invested by a separate peritoneal covering, projects into or behind the unobliterated sac, like a viscus into a serous membrane, the hernia is named *infantile.*

Internal hernia comes behind external ring.

The Internal or Direct Inguinal Hernia passes through the wall of the abdomen internal to the epigastric artery, and has a straight course through the abdominal parietes and the external abdominal ring. Its situation and coverings, and the seat of stricture, will be better comprehended after the examination of the part of the abdominal wall through which the hernia passes.

It passes through a triangular space, which is strengthened in part by conjoined tendon.

Anatomy. — At the lower part of the abdominal wall is a small triangular space between the epigastric artery on one side, the outer edge of the rectus muscle on the other, and the inner half of Poupart's ligament below. Over the inner two thirds of the area of the space the conjoined tendon of the internal oblique and transversalis is stretched, as it descends to its insertion into the pectineal line; but at the

outer third there exists only fascia transversalis. Any intestine protruding in this spot must, it is evident, rupture or elongate the different structures, because there is not any aperture or tube by which it can descend, as in the external hernia. Further, the coverings of the hernia, and its extent and direction in the lower part of the inguinal canal, must vary according as the gut is forced through the part of the space covered by the conjoined tendon, or through the part external to that tendon.

Hernia in this space of two kinds.

Course and coverings of the hernia. — The common kind of the internal hernia (inferior) passes through the inner part of the triangular space which is covered by the conjoined tendon, and then straight through the abdominal wall to the external ring; since it does not accompany the cord along the inguinal passage. The intestine in protruding carries before it the peritoneum, the subperitoneal fatty membrane, and the fascia transversalis; next, it either elongates the conjoined tendon, or, as is the case in a sudden rupture, separates the fibres, and escapes between them. Then, the intestine advances into the lower part of the inguinal canal, where it is opposite the external abdominal ring; and it passes outwards through the ring, lying on the inner side of the cord, and receiving at the same time the covering of the fascia spermatica. Lastly, it is invested by the superficial fascia and the skin. In number the coverings of this internal hernia are the same as those in the external form; and in kind they are the same, with this exception, viz. that the conjoined tendon is substituted for the cremasteric covering.

Coverings of the more common kind are peritoneum and subjacent fat, fascia transversalis, conjoined tendon, spermatic fascia, superficial fascia, and skin.

Seat of stricture. — The stricture in this form of hernia occurs most frequently at the neck of the sac, next in frequency at the margin of the fissured tendon, and lastly at the external abdominal ring. The position of the openings in the abdominal wall should be kept in mind during attempts to reduce an internal hernia; and the straightness of the course of the intestine, in a comparison with an external hernia, should be remembered. Where it is necessary to open the hernial sac to relieve the stricture, after having divided constricting bands external to the neck, the cut is to be made directly upwards as in the external hernia.

Stricture. Situation.

Its division.

Variety of internal hernia. — Another kind of internal

Rarer kind of

internal hernia is farther out than the preceding in the triangular space, and is oblique in direction.

hernia (superior) projects through the part of the area of the triangular space, where only the fascia transversalis is found. Its existence is dependent upon the position of the obliterated hypogastric artery behind the wall of the abdomen (p. 495.). If this hernia existed, it is evident that it would pierce the abdominal wall close to the epigastric artery, and would descend along nearly the whole of the inguinal canal to reach the external abdominal ring; consequently the term direct will not apply strictly to the form of internal hernia now under consideration.

Coverings are same as in external hernia.

Coverings. — As this internal hernia traverses nearly the whole of the inguinal canal, it has exactly the same number and kind of coverings as the external hernia that accompanies the spermatic cord, viz. the skin and the superficial fascia, the spermatic and cremasteric fasciæ, the fascia transversalis, and the subperitoneal fat and the peritoneum.

Stricture at same spots. Division of it.

Seat of stricture. — The constriction of the intestine will take place at the same spots as in the external hernia; and from the inability always to decide, in the living body, whether the kind of hernia is internal or external, the rule observed in dividing the deep stricture is to cut directly upwards, as in the other kinds of inguinal hernia.

Umbilical hernia. Course.

Umbilical Hernia, or exomphalos, is a protrusion of the intestine either through or by the side of the umbilicus. It is very variable in size, and its course is straight through the abdominal wall.

Coverings become united over the tumour.

Coverings. — The coverings of the intestine in a small hernia are thin, and few in number, viz. the skin and the superficial fascia, a prolongation from the tendinous margin of the abdominal opening, together with the remaining common coverings of the fascia transversalis, the subperitoneal fat and the peritoneum. If the hernia is suddenly produced, it may want the investment that otherwise is derived from the tendon of the external oblique muscle. Over the end of the tumour the fat of the superficial fascia disappears, and this covering becomes blended with the other contiguous structures.

Stricture, where found.

Seat of stricture.—The stricture on the intestine is generally found at the margin of the tendinous opening in the abdominal wall; and it should be remembered that this opening is at the upper part, not in the centre of the swell-

ing. The constriction may be removed by cutting from above, or upwards if the sac is opened, but there is not any vessel to be injured in the operation.

OTHER FORMS OF HERNIA.— At each of the other natural apertures in the parietes of the abdomen, a piece of intestine may be protruded, so as to form a hernial tumour. For instance, there may be *femoral hernia* below Poupart's ligament, with the femoral vessels; *obturator hernia* through the thyroid foramen, with the artery of the same name; and *ischiatic hernia* through the ischiatic notch. The femoral hernia, as the most important, will be noticed presently; but the student must refer to some special treatise * for his information respecting the other abdominal herniæ. (Other abdominal herniæ are femoral, obturator, ischiatic.)

Dissection.— The abdomen may be now opened to see the cords and the depressions on the posterior aspect of the abdominal wall, below the umbilicus. For that purpose a transverse cut is to be made through the umbilicus across the front of the abdomen. On holding up the lower part of the abdominal wall certain cords will be seen ascending to the umbilicus from the pelvis. (Dissection.)

Cords of the abdominal wall. — In the middle line of the abdominal wall, at its posterior aspect, is the prominence of the remains of the urachus, which reaches from the summit of the bladder to the umbilicus. On each side is another cord, formed by the obliterated hypogastric artery; this is directed from the side of the pelvis to the umbilicus, and lies usually behind or close to the epigastric artery, near Poupart's ligament. (Cords inside abdomen; one in middle line, another on each side,)

Fossæ. — When the disposition of the cords is such as above mentioned, two fossæ are seen near Poupart's ligament, one on each side of the obliterated hypogastric artery, corresponding with the situation of the internal and external abdominal rings, and with the places where the external and internal (common kind) herniæ occur. But occasionally the cord of the obliterated hypogastric is moved inwards from the line of the epigastric artery, and lies behind the triangular space between this artery and the edge of the rectus, at the line of junction of the outer with the inner two thirds of the space. In this last case there would be a hollow or (forming two fossæ. Sometimes last cord moved inwards causing)

* *A Treatise on Ruptures*, by W. Lawrence, F.R.S.

three fossæ.

fossa at the lower part of the abdomen on each side of that cord, corresponding with the subdivisions of that triangular space, and with the spots at which the two kinds of internal hernia escape. When the hypogastric cord has the unusual position last mentioned, there may be three fossæ at each side, on the lower part of the abdominal wall; one between it and the urachus, another between it and the epigastric, and a third outside the epigastric artery. The presence of these fossæ determines the production of the different kinds of inguinal hernia; there being one, two, or three, on each side, according to the fossæ.

Number of the hernial protrusions same as fossæ.

Situation of the femoral hernia.

FEMORAL HERNIA. — In this hernia the intestine leaves the abdomen below Poupart's ligament, in the loose membranous sheath that surrounds the femoral vessels. The course that the intestine takes, and the coverings that it receives, will be readily understood after the anatomy of the parts among which it passes has been learnt. Only so much of the structures will be described here, as can be now seen, the rest are fully noticed in the dissection of the thigh.

Dissection of the parts concerned.

Dissection. — The examination of the parts concerned in the femoral hernia is to be made on the left side of the body. The lower portion of the abdominal wall is to be divided from the umbilicus to the pubes, and the peritoneum is to be detached from the inner surface of the wall, and from the iliac fossa. The layer of the subperitoneal fat is next to be separated in the same way, but before doing this it will be necessary to cut through the cord at the abdominal ring: as this layer is raised, one or more lymphatic glands will be seen by the side of the iliac vessels. Any loose tissue that remains, is to be taken away to show the upper opening of the membranous sheath which contains the femoral vessels. In this dissection the genito-crural nerve is seen on the iliac artery. Afterwards the iliac fascia and the fascia transversalis are to be traced to Poupart's ligament, to see the part that each takes in the production of the crural sheath.

Anatomy of the structures.

Anatomy. — The structures concerned in the femoral hernia are severally to be examined, viz. the subperitoneal fat; the membranes (transversalis and iliac fascia) lining the interior of the abdominal cavity near Poupart's ligament, with the sheath to which they give origin; and, lastly, the crural ring, or the space through which the hernia leaves the abdomen.

The *subperitoneal fat* extends as a continuous layer beneath the peritoneum, though it is thickest and most fibrous at the lower part of the abdomen, where the vessels pass under Poupart's ligament. At that spot it extends over the upper opening of the sheath of the vessels, instead of descending around the vessels; and internal to the vein, it covers a space named crural ring, as well as a lymphatic gland which occupies that space. The piece of the layer that stretches over the crural ring is named by M. Cloquet *septum crurale*, and is described by him as being concave towards the abdomen, and convex towards the thigh; some apertures exist in it for the ducts of the inguinal glands, and one gland is generally attached to its under surface.

Subperitoneal fat

forms septum crurale.

The *fascia transversalis* has been before described (p. 482.). When traced down to Poupart's ligament, it may be seen to join the iliac fascia external to the situation of the large iliac artery; but internal to that spot it is continued downwards to the thigh, in front of the femoral vessels, and forms the anterior part of the crural sheath.

Fascia transversalis.

The *iliac fascia* covers the iliacus muscle, and lies beneath the iliac vessels. At Poupart's ligament its disposition is found to resemble that of the transversalis fascia; for external to the iliac vessels it joins that fascia along the line of the ligament; but, internal to the spot mentioned, it is prolonged behind the vessels into the posterior part of the crural sheath.

Iliac fascia.

The *crural* or *femoral sheath* is the loose membrane that encloses the femoral vessels as these enter the thigh: it is derived from the membranes that line the abdomen — its anterior half being continuous with the fascia transversalis, and its posterior half with the fascia iliaca. The whole of the upper part of the sheath is not filled by the vessels, for a space (crural ring) exists on the inner side of the vein, which contains a gland, and through which the intestine descends in femoral hernia.

Sheath on femoral vessels formed by offsets of preceding.

The *crural ring* is partly described in the dissection of the thigh, but its boundaries are better seen now in the examination of the abdomen. It is the interval in the sheath, at the inner side of the femoral vein; it is about half an inch wide, and is filled by a lymphatic gland. Close to the sheath, bounding it internally, are Gimbernat's ligament and the

A space on inner side of the vessels is the crural ring.

Size and boundaries.

conjoined tendon, and externally is the femoral vein. In front of the sheath is Poupart's ligament with the deep arch, and behind is the pubes. Along the front of the space, but outside the tube of membrane, lies the spermatic cord in the male, and the round ligament in the female.

Usual vessels around ring.

Position of vessels around the ring.—Commonly the crural ring is almost surrounded by vessels. Thus, on the outer side is the femoral vein; and above this, on the outer side, are the epigastric vessels. In front is a small branch (pubic) from the epigastric artery to the back of the pubes; and the vessels of the spermatic cord may be said to be placed along the anterior aspect of the ring. The ring is bounded therefore by vessels, except internally and behind.

State of the unusual vessels.

But in some bodies the obturator artery takes origin from the epigastric, and comes to lie along a part of the ring as it passes to the pelvis. In that course it may have two positions with respect to the ring: either it lies close to the iliac vein, and therefore on the outer side of the ring; or it arches over the ring, descending on the inner side, at the base of Gimbernat's ligament. If the artery takes the first-mentioned course, which is the most frequent arrangement, the inner side of the ring will be still free from vessels; but in the other condition the ring will have an additional vessel on the inner side, and will be entirely encircled except at the posterior part.

Course and coverings of the hernia.

Course and coverings of femoral hernia.—The intestine leaves the abdomen by the opening of the crural ring; and it descends in the large sheath on the vessels, internal to the vein, as far as the saphenous opening, where it projects to the surface of the thigh. In its progress the intestine will push before it the peritoneum, the subperitoneal fat (septum crurale), and will displace, or cause to be absorbed the gland that fills the crural ring. Having reached the level of the saphenous opening, the intestine carries before it the inner side of the crural sheath and the cribriform fascia; and, lastly, it receives coverings from the superficial structures of the thigh. The dissection of the thigh may be referred to for fuller detail.

From abdomen it has peritoneum and subperitoneal fat.

Inner part of sheath.

Stricture

Seat of stricture.—The stricture of a femoral hernia is either in the neck of the sac, opposite the base of Gimbernat's ligament; or lower down, at the margin of the saphenous

opening in the thigh. To free the intestine from the constricting band of the saphenous opening and Gimbernat's ligament, an incision is to be made down to the neck of the sac at the inner and upper part; and to relieve the deep stricture within the neck of the sac, the knife is to be carried horizontally inwards, or upwards and inwards through the thickened sac, and a few fibres of the free edge of Gimbernat's ligament. either in neck, or at saphenous opening. Incision to divide it.

Danger to vessels.— When the incision is made upwards and inwards to loosen the deep constricting band, there will not be any vessel injured unless, indeed, the cut should be made so long as to reach the spermatic cord, or the small pubic branch of the epigastric artery. And in the division of the stricture inwards with the same view, there is not, in ordinary cases, any vessel on the inner side of the ring, and therefore in the way of the knife, as this is carried inwards. But in some few instances (once in about eighty operations, Lawrence), the obturator artery takes its unusual course, lying in front of and on the inner side of the neck of the sac, and will be before the knife in the division of the stricture. This condition of the vessel cannot be recognised beforehand, but the surgeon would best avoid the danger of wounding the artery by a cautious and sparing use of the knife. Risk of wounding vessels in regular and irregular condition of them.

Section III.

CAVITY OF THE ABDOMEN.

The abdominal cavity is the space included between the spinal column and the visceral arches continued forwards from it, with the intervening muscles. It contains the digestive, urinary, and generative organs, and their vessels and nerves. Definition and contents.

Dissection. — To prepare the cavity for examination, the remainder of the abdominal wall above the umbilicus is to be divided by a cut along the left side of the linea alba as far as the xiphoid cartilage, and the flaps are to be thrown to the sides. Dissection to open abdomen.

Size and form.— This space is the largest in the body. It is oval in form with the ends of the oval upwards and Is largest in the body.

Is oval. downwards, so that it measures more in the vertical than the transverse direction; and it is much wider superiorly than inferiorly.

Above is the diaphragm; below levator ani. *Boundaries.*— Above it is limited by the diaphragm; and below by the levatores ani, and the structures that close the outlet of the pelvis: both these boundaries are in part fleshy, and concave towards the contents of the cavity, so that the viscera will be acted on by their contraction and flattening.

In front and on sides, bones and muscles. In front and on the sides the parietes are partly osseous and partly muscular: thus towards the upper and lower limits is the bony framework of the body, viz. the ribs in one direction and the pelvis in the other; but in the centre are the muscles of the abdominal wall.

Behind is spine. Behind is the spinal column with the muscles contiguous to it, viz. the psoas and the quadratus lumborum.

Depth is altered by action of diaphragm and levator ani. *Alterations in size.*— The dimensions of the cavity are influenced by the varying conditions of the boundaries. The depth is diminished by the contraction and descent of the diaphragm, and the contraction and ascent of the levatores ani; and is restored to its former dimensions by the relaxation of those muscles.

Width by muscles in wall of abdomen. The width is lessened by the contraction of the abdominal muscles; and is enlarged during their relaxation by the action of the diaphragm and the levatores ani driving outwards the viscera.

How excreta expelled. The greatest diminution of the space is effected by the simultaneous contraction of all the muscular boundaries, as in the expulsion of the excreta.

Division of space. *Divisions of the space.*— An arbitrary division has been made of the space into that of the pelvis and that of the abdomen proper.

Pelvic portion. The *pelvic* portion is situate below the brim of the pelvis, and contains chiefly the generative and urinary organs.

Abdomen proper. The *abdominal* portion reaches from the diaphragm to the brim of the pelvis, and lodges the alimentary tube and its appendages, together with the kidneys—the secretory organs of the urine. A serous membrane, the peritoneum, lines the cavity, and covers the viscera.

Abdomen proper here described. The following description concerns the part of the cavity between the diaphragm and the brim of the pelvis.

Pelvis after. Towards the end of the dissection of the abdomen, the cavity of the pelvis will receive a separate notice.

Regions.— The larger upper part of the abdominal cavity is divided artificially into regions by lines extended between certain points of the parietes. If two circular lines are carried round the body, so that one shall be opposite the cartilage of the ninth rib, and the other on a level with the most prominent point of the crest of the hip bone, the abdominal cavity will be divided into three parts or zones, upper, middle, and lower. Each of these zones will be further subdivided into three by two lines, one on each side, from the cartilage of the eighth rib to the centre of Poupart's ligament. This vertical line will mark off on each side a piece from each of the three circles, which is named respectively, from above downwards, hypochondriac, lumbar, and iliac (right and left); whilst the central part of each is designated from above down, epigastric, umbilical, and hypogastric. In addition, the central and lower part of the hypogastric subdivision is named pubic region, whilst its lateral portion is known as the inguinal region. Abdominal cavity is marked out into regions. Lateral and central.

Contents and their position.— The alimentary tube and its accessory parts, the liver, pancreas, and spleen, occupy the upper division of the cavity of the abdomen. The kidney is also situate in the same part of the abdominal space. Parts in cavity.

The alimentary tube presents differences in form, and is divided into stomach, small intestine, and large intestine; and each of these portions is further subdivided as it will afterwards appear. The several viscera have the following general position: — General division of alimentary tube

The small intestine is much coiled, and occupies the greater part of the cavity; whilst the great intestine arches around it. Both are fixed in position by folds of the serous lining. Above the arch of the great intestine are situate the stomach, the liver, the spleen, and the pancreas; and below it is the convoluted small gut. Behind the large intestine on each side is the kidney with its excretory tube. and position. Position of successive parts: of kidney.

Superficial view of the contents.—On first opening the abdomen the following viscera appear: — On the right side is the liver, which is partly concealed by the ribs. On the left side a part of the stomach is visible; but this viscus lies chiefly beneath the ribs, and is somewhat overlaid by the liver. Descending from the stomach is a fold of peritoneum (the large omentum), which reaches to the pelvis, and con- Parts of viscera seen without displacement.

ceals the intestine: in some bodies the omentum is raised into the left hypochondriac region, and leaves the small intestine uncovered. If the bladder is distended, a small part of it may come into view just above the pelvis.

CONNECTIONS OF THE VISCERA.

Connections of viscera to be seen.

Before the natural position of the viscera is disturbed, their connections with the surrounding parts, and their situation in the different regions of the abdomen should be examined.

Position of stomach.

The stomach. — The stomach intervenes between the gullet and the small intestine, and is retained in position partly by folds of the serous membrane. It is somewhat of a conical form, with the larger end to the left side; and it occupies the left hypochondriac, the epigastric, and part of the right hypochondriac region.

Extremities, large

At the left end it receives the œsophagus, and it is firmly fixed by this tube to the diaphragm. This end lies beneath the ribs, and is in contact with the spleen, to which it is connected by a fold of peritoneum (splenic omentum): when this part of the stomach is distended it pushes up the diaphragm, and encroaches on the space for the heart and the left lung. The right extremity ends in the small intestine, and reaches towards the gall bladder; it is in contact with the wall of the abdomen and the under surface of the liver.

and small.

Surfaces.

The anterior surface is in contact, from left to right, with the diaphragm, the abdominal wall, and the under part of the liver; and the posterior surface corresponds with the pancreas, the pillars of the diaphragm and the aorta, and the solar plexus.

Borders.

The upper border is connected to the liver by a fold of peritoneum, the small omentum; and the lower border gives attachment to another peritoneal fold, the great omentum or epiploon, which floats freely over the intestine.

Connections depend on its condition.

The connections with the surrounding parts will be influenced by the condition of the stomach: for when this viscus is empty its surfaces look forwards and backwards, and its borders upwards and downwards; but when it is distended, it becomes somewhat circular, and makes a rotatory movement, so as to bring forwards the border usually lowest,

and to turn upwards that surface which is directed forwards at other times.

The position and the connections of the stomach may be also changed by an alteration in the size of any of the surrounding organs, or by accumulation of fluid in the chest, or in the belly. The stomach may be likewise dragged down by the great omentum entering a hernial sac, or it may be forced down towards the pelvis by the pressure of tight stays. In all these different changes in its position, the right end moves more than the left, because it is attached only by peritoneum to the parts around. Alterations in position from disease.

The small intestine. — The smaller part of the intestinal tube (intestinum tenue) reaches from the stomach to the right iliac region, where it ends in the large intestine. It is divided into three parts, duodenum (twelve fingers intestine), jejunum, and ileum; of the last two, one receives its name from its empty condition, and the other from its numerous coils. Small intestine. Situation and divisions.

The *duodenum* cannot be satisfactorily seen at present, and it will be examined afterwards. Duodenum.

The *jejunum* and *ileum* begin on the left side of the second lumbar vertebra, without any distinct mark of separation from the duodenum. Two-fifths of the intestine are given to the jejunum, and the remaining three-fifths to the ileum. This part of the intestinal tube forms many convolutions in the umbilical, hypogastric, lumbar, and iliac regions of the abdomen; and it descends oftentimes in the female into the cavity of the pelvis. In front of the convolutions is the great omentum; and posteriorly the small intestine (beyond the duodenum) is fixed to the spine by a fold of peritoneum named the mesentery, which contains the vessels and nerves. Surrounding the jejunum and ileum is the large intestine or colon; but on the left side of the body the large is concealed by the small intestine. Jejunum and ileum. Situation. Connections.

The large intestine. — The large gut or the colon is sacculated, and is less moveable than the small intestine. It begins in the right iliac region in a dilated part or head (caput cæcum coli), and ascends to the liver through the right iliac, lumbar, and hypochondriac regions. Then crossing the abdomen below the stomach, it reaches the left hypochondriac region; and it lies in this transverse part of its Large intestine how distinguished. Course

course between the epigastric and umbilical regions, or altogether in the latter. Finally, it descends on the left side through the regions corresponding with those it occupied on the right, forms a remarkable bend (sigmoid flexure) in the left iliac fossa, and enters the pelvis to end on the surface of the body. It takes an arched course around the small intestine, and is divided into six parts, viz. cæcum, ascending colon, transverse colon, descending colon, sigmoid flexure, and rectum.

and extent.

Divisions.

Cæcum, or head of colon.

Situation

and connections.

The *cæcum* (caput cæcum), or the commencement of the colon, is placed in the right iliac fossa, in which it is fixed by the peritoneum stretched over it. In front usually are the convolutions of the small intestine, but when it is distended it touches the abdominal wall. Behind, it rests on the iliac fascia, only fatty and connective tissues intervening. On the inner side it is joined by the small intestine; and it presents inferiorly a worm-like piece—the vermiform appendix. Sometimes the peritoneum surrounds the cæcum, and attaches it by a fold to the abdominal wall.

Ascending colon.

Parts around.

The *ascending colon* reaches from the cæcum to the under surface of the liver, on the right of the gall bladder. It lies against the quadratus lumborum inferiorly, but higher up it is placed in front of the kidney. The peritoneum fixes it immoveably to the wall of the abdomen; and surrounds commonly about two-thirds of the circumference, but it may be found to encircle the tube, and form a fold behind, as in the cæcum. To its inner side are the convolutions of the small intestine.

Connections of the transverse colon:

is most moveable piece of large intestine.

The *transverse colon* passes obliquely upwards and to the left, along the curvature of the stomach, as far as the spleen; in this course it is deeper at each end than in the middle, and, by being thus bent, forms the arch of the colon. In this extent it has above it the liver and the gall bladder, the stomach and the spleen; and below it the small intestine. In front is the great omentum; and behind is a fold of peritoneum, the transverse meso-colon, which attaches it to the back of the abdominal wall, and contains its vessels and nerves. The transverse colon is more moveable than any other part of the large intestine, its peritoneal fold allowing it to be raised and placed on the margin of the ribs. Small

pieces of peritoneum, containing fat, the appendices epiploïcæ, are fixed along it.

The *descending colon* commences below the spleen, and reaches to the left iliac fossa. At first it is deeply placed in the left hypochondriac region, and in its whole course it is deeper than the right colon. In front of it are the convolutions of the small intestine; and behind are the diaphragm, the outer part of the kidney, and the quadratus lumborum. This part of the intestine is smaller than either the right or the transverse portion; and it is less surrounded usually by the peritoneum attaching it to the abdominal wall.

Descending colon.

Situation.

Is covered by small intestine.

The *sigmoid flexure* of the colon is situate in the left iliac fossa, to which it is attached by a fold of the peritoneum, the sigmoid meso-colon, but it often extends partly into the cavity of the pelvis. The intestine makes two turns like the letter S, and has obtained its name from that circumstance. It is concealed by the small intestine, which is directed more to the left than to the right side. The extent of this part of the colon is from the crest of the hip bone to the junction of the same bone with the sacrum, where it ends in the rectum.

Sigmoid flexure

is in left iliac fossa.

The *rectum* is the termination of the large intestine, which is contained in the pelvis: it will be seen in the dissection of that cavity.

Rectum.

The liver. — The liver is situate in the right hypochondriac, and epigastric regions, and reaches slightly into the left hypochondriac. Folds of peritoneum (ligaments) retain it in place.

Position of the liver.

The upper surface is convex, and turned to the vault of the diaphragm, and is divided into two parts by the suspensory ligament; the right half, more prominent than the left, reaches to the level of the fifth intercostal space. The under surface is in contact with the stomach and the duodenum, with the ascending colon, and with the right kidney and the suprarenal body. Attached to this surface is a fold of the peritoneum (small omentum) that contains the hepatic vessels.

Surfaces.

The anterior border is thin, and is constantly varying its position to the wall of the thorax according to the distension of the stomach, and the position of the body and the diaphragm. This edge, except a small part near the xiphoid cartilage, lies in adult males usually within the margin of

Borders.

the ribs, but in women and children it projects below that line. The gall bladder projects beyond this edge. The posterior border is thick, and is connected to the diaphragm by certain ligaments or folds of the peritoneum; it lies on the large vessels (aorta and cava), and on the pillars of the diaphragm.

Position is chang-ed by dia-phragm, by pos-ture of body,

The liver is constantly changing its situation with the ascent and descent of the diaphragm in respiration; thus in inspiration it descends, and in expiration it regains its former level. In the upright and sitting postures this viscus descends lower than in the horizontal condition of the body; so that in the former state, the anterior border may be felt underneath the edge of the ribs, but in the latter it is withdrawn within their margin. The connections of the liver with the surrounding parts may be changed by the growth of tumours, by collections of fluid in the chest or in the abdomen, or by constricting the space for its lodgement, as in tight lacing.

and by disease in other parts.

Situation of spleen.

The spleen.—The spleen lies deeply in the left hyponchondrium, between the stomach and the ribs, and is connected by peritoneum to the great end of the stomach on the one side, and to the diaphragm on the other side. Its position is almost vertical. Its outer surface is convex: it corresponds with the diaphragm, and is opposite the ninth, tenth, and eleventh ribs. At the inner surface, which is concave, the vessels enter, and to it a fold of peritoneum, the gastro-splenic omentum, is attached; in front of the vessels it touches the stomach, and behind them it is in contact with the left crus of the diaphragm, the suprarenal capsule, and the tail of the pancreas. Below the spleen are the kidney and the beginning of the descending colon. When the stomach is distended the spleen is somewhat behind it.

Connections.

Kidney

The kidney.—The kidney should be examined on the left side of the body, so that the duodenum may not be displaced. In order that it may be seen, the descending colon and the peritoneum must be separated from the abdominal wall. This viscus is surrounded with fat, and is situate in the lumbar region (one on each side), opposite the last dorsal, and the upper two or three lumbar vertebræ. Its position is somewhat oblique, so that the upper is nearer than the lower end to the spinal column. In front of the kidney are the

occupies lumbar region.

Parts in

peritoneum and the colon; and behind it are the quadratus lumborum and psoas muscles, with the diaphragm and the last rib. Above each kidney and resting on it, is the supra-renal capsule; and below each is the iliac crest. The inner border looks to the spine and receives the vessels; whilst the outer border projects towards the side of the abdominal wall. Sometimes the two are united in front of the aorta, and form the horse-shoe kidney. front, behind, above, below, inside.

Difference on opposite sides. — The right kidney is placed rather lower than the left; it reaches as high as the lower border of the last rib but one, whilst its fellow is opposite the upper border of the corresponding rib. In front of the right, in addition to the common connections before specified, is the duodenum; and before the left one is the lower end of the spleen. Above the right is the liver, and above the left the spleen. Right highest. Different parts before and above.

The *connections* of the *pancreas* may be omitted for the present. Pancreas.

THE PERITONEUM.

This is the largest serous membrane in the body. Like other membranes of the kind it is a closed sac, except in the female, in whom its cavity is continuous with the canals of the Fallopian tubes. One part of it lines the wall of the abdomen (parietal layer), and another is reflected over the different viscera (visceral layer), except where the vessels enter. The inner surface is smooth; but the outer is rough, when it is detached from the surfaces with which it is naturally in contact. The membrane forms folds as it passes from viscus to viscus along the vessels; these attach the viscera to the abdominal wall, and consist for the most part of two layers, one on each side of the vessels. Peritoneum consists of a parietal and visceral layer, and forms folds on vessels.

The continuity of the sac may be traced in both a horizontal and a vertical direction.

Horizontal circle around the abdomen. —If the membrane be followed outwards from the umbilicus, it will be found partly to enclose the large intestine, and to fix it to the abdominal wall. From the colon it may be traced over the kidney as far as the middle line, where it is reflected along the vessels going to the small intestine, then over the intestine, and finally back to the spine along the other aspect of the vessels. Lastly it may be pursued outwards Continuity of the membrane around the body, opposite umbilicus.

to the right colon, which it encircles like the left, and along the wall of the abdomen to the umbilicus. The membrane that fixes the colon on each side to the abdominal wall, is named meso-colon, and that attaching the small intestine is the mesentery.

Continuity of the serous membrane from above down;

Vertical circle or from above downwards.—Beginning at the liver, the student may perceive that the peritoneum covering it is prolonged from the under surface of that viscus on the vessels. From the liver it may be followed along those vessels, one piece before and the other behind them, forming the small omentum, to the upper border of the stomach. At the stomach the two pieces enclosing the vessels separate, one going before, and the other behind it; but beyond that viscus, they are applied to one another to form the great omentum or epiploon. After descending in contact in that fold to the lower part of the abdomen, they may be traced in it backwards and upwards, and may be seen to separate to enclose the transverse colon like the stomach, and then to continue to the spine, giving rise to the transverse meso-colon. At the attachment of the transverse meso-colon to the spine, the two companion pieces will be found to separate,— one passing upwards, the other downwards.

forms pouch of omentum,

a. The ascending piece is continued in front of the pancreas and the pillars of the diaphragm, and blends with the peritoneum on the posterior aspect of the liver: in its ascent it forms the posterior part of a pouch, which is behind the stomach.

and descends over the intestine to the pelvis.

b. The descending piece or layer may be followed from the transverse meso-colon along the middle line of the spine, over the duodenum and the great vessels on the spine (aorta and cava), till it meets with the artery to the small intestine, along which it is continued to form the mesentery, as before explained in tracing the peritoneum in a circular direction. From the root of the mesenteric artery the peritoneum descends to the pelvis, and partly covers the viscera in that cavity. Thus it surrounds the upper part of the rectum, and attaches this viscus to the abdominal wall by the meso-rectum; next, it is continued forwards between the rectum and the bladder, or between the rectum and the uterus, where it forms a pouch; thence it passes from the pelvis over the back and sides of the bladder. Lastly, the serous membrane is continued to the inguinal region, where it presents the pouches before alluded to (p. 495.); and it can be traced upwards on the wall of the abdomen and the diaphragm to the rest of the membrane on the upper surface of the liver.

Chief folds of the peritoneum.

Folds of the peritoneum. — After tracing the continuity of the serous sac over the viscera, the student is to examine the chief folds or processes of the membrane in connection with the alimentary tube. The pieces of the peritoneum that fix

the liver will be examined afterwards: and the folds on the viscera of the pelvis will be learnt with the dissection of that cavity.

Folds on the stomach.—The processes of the serous membrane in connection with the stomach are named omenta. They are three in number: — one, small omentum, is attached to the upper curve; another, great omentum, to the lower curve; and the third, splenic omentum, is fixed to the great end of the viscus. On the stomach omenta.

The *small* or *gastro-hepatic omentum* is stretched between the under surface of the liver and the upper border of the stomach, and contains the vessels and nerves of the liver. It is formed by two pieces of peritoneum, as before explained, and presents a free border on the right side. Behind it is the space called foramen of Winslow. Its lower border is fixed to the small curve of the stomach; whilst its upper border is attached to the transverse fissure, as well as to the posterior half of the longitudinal fissure of the liver, becoming blended with the left lateral ligament of that viscus. Small omentum. Situation. Attachments.

The *gastro-colic* or *great omentum* is the largest fold of the peritoneum, and consists of two pieces or layers, continuous with those on the front and back of the stomach. It is attached to the spleen, and the lower border of the stomach where the pieces are separated by vessels, and then descends in front of the intestine, but lower on the left than the right side of the body. At the lower part of the abdomen the fold is bent backwards, and returns towards the spine, the pieces of which it is composed separating and enclosing the transverse colon as before seen. Between the layers of the peritoneum are contained some fat, and some vessels and nerves; and the power of separating the one from the other diminishes with the increase of the distance from the stomach, until at last they are not to be separated, and the membrane they form is thin and net-like. The anterior part of the omentum is separated from the posterior by a space (bag of the omentum), that extends a varying distance. Great omentum. Attachments. Forms a fold in front of small intestine. Consists of two layers.

a. Cavity or bag of the great omentum. — When an opening is made through the great omentum, near the stomach, and this viscus is raised, a large space is seen to extend upwards to the liver, and downwards into the omentum. This is the omental sac. In front the space is bounded by the small omentum, the stomach, and the anterior part of the great omentum. Behind it are the posterior Bag of the omentum. Boundaries.

part of the great omentum, with the transverse colon, and the transverse meso-colon with its ascending layer. Above is the liver; and below is the doubling of the great omentum. This bag communicates with the rest of the peritoneal cavity, through the space (foramen of Winslow), behind the small omentum. If the bag of the omentum were perfect, it could be inflated through the foramen; or if it were detached from the surrounding parts, it could be drawn through the same hole into the general bag of the peritoneum. Supposing it to be detached and drawn out, the following parts would have peritoneum taken from them, viz. the small omentum (posterior piece), the posterior part of the stomach, the great omentum (inner piece), the upper surface of the transverse colon, the pancreas and the spine, and the posterior part of the liver. Should this piece of peritoneum be removed, there is not any hindrance to the vessels reaching the different viscera; and it may be readily conceived how the detached membrane could be replaced over the viscera, and around the vessels without being perforated by them.

Opens into general cavity by foramen of Winslow.

Foramen of Winslow.

b. The *foramen of Winslow* is the space behind the small omentum, through which the bag of the omentum opens into the general cavity of the peritoneum. In front of it is the small omentum, and behind are the vena cava and the spine. Above it is the liver (lobulus Spigelii), and below is the duodenum. Should this hole be closed by inflammation, there might be a dropsical collection in either the bag of the omentum, or the general bag of the peritoneum.

Splenic omentum.

The *splenic omentum* reaches from the great end of the stomach to the concave surface of the spleen, and does not consist usually of two strata or pieces, like the other omenta. It covers the vessels passing between the two viscera, and is continued inferiorly into the great omentum.

Peritoneum attaching large intestine forms

Folds on the large intestine. — The large intestine is connected to the wall of the abdomen by folds of the peritoneum (meso-colic), which are formed of two pieces, as the other processes. Each part of the colon has a separate meso-colon attaching it: thus there is an ascending, a transverse, a descending, and a sigmoid meso-colon: the cæcum is also fixed by a meso-cæcum, and the rectum by a meso-rectum.

Meso-cæcum.

a. The *meso-cæcum* attaches the cæcum to the right iliac fossa. Usually the peritoneum does not surround the cæcum so as to form a fold behind it, but in some bodies the serous membrane does give a suspensory band to that part of the intestine.

b. By the *ascending* and the *descending meso-colon,* the ascending and the descending part of the colon are kept in place. In these folds, as in that of the cæcum, the peritoneum is not commonly in contact behind the intestine, though it may meet behind and form processes. The *sigmoid meso-colon* is a long piece of the serous membrane, and attaches the sigmoid flexure of the colon to the left iliac fossa. The *meso-rectum* contains the hæmorrhoidal vessels, and connects the rectum to the front of the sacrum.

Ascending, descending, and sigmoid meso-colon.

c. The *transverse meso-colon* is a more perfect fold than either of the others connected with the large intestine, and serves as a partition between the small intestine and the stomach, liver, and spleen. By one side it is fixed to the colon, and by the other side to the abdominal wall below the pancreas. It is formed of two layers of peritoneum, as before said, which enclose the vessels of the colon.

Transverse meso-colon.

Small processes of the peritoneum are attached along the tube of the great intestine, chiefly to the transverse colon; they are the *appendices epiploïcæ,* and contain fat.

Appendices epiploïcæ.

Folds of the small intestine. — The small intestine is not enveloped by the peritoneum after the same manner through all its extent. For whilst the jejunum and ileum are attached to the abdominal wall by one fold (mesentery), the duodenum has special connections with the serous membrane.

Peritoneal covering of small intestine.

Serous covering of the duodenum. — The first part of the duodenum is surrounded by peritoneum, like the stomach; the next part is covered only in front; and the last part, which crosses the aorta, is but slightly in contact with the serous membrane, for it lies at first between the strata of the transverse meso-colon, and then beneath the upper part of the superior mesenteric artery.

Peritoneum on duodenum.

The *mesentery* supports the rest of the small intestine (jejunum and ileum), and is stronger than any other of the folds of the serous membrane. Its inner end is narrow, and is attached to the spine, from the left side of the second lumbar vertebra to the junction of the right hip bone with the sacrum. The other end of the fold is wide, and is connected with the intestine. Between its two layers are the superior mesenteric vessels and nerves, with lymphatic glands and lacteals.

Mesentery. Form. Attachments. Parts contained in it.

Ligaments of the liver. — The reflections of the peritoneum

Peritoneal

folds of the liver. between the liver and the wall of the abdominal cavity are named ligaments. There is a suspensory fold along the upper part, containing the obliterated umbilical vein; and there is a coronary ligament along the posterior border.

Suspensory ligament. The *suspensory* or *falciform ligament* is placed between the upper convex surface of the liver and the parietes of the abdomen. Shape. It is falciform in shape; in the recumbent position of the body, it has the base turned forwards, and the apex backwards. Attachments. The lower border is concave, and is attached to the liver; whilst the opposite border is convex, and is connected to the abdominal wall on the right side of the linea alba, and to the under part of the diaphragm. Contains round ligament. In its base or free part is contained the remnant of the umbilical vein, which is named the *round ligament.* This fold is produced by the passage of the umbilical vein to the liver, How formed. above the sac of the peritoneum; and with a little care the dissector will be able to detach the serous membrane from the vein, and to trace the sac continuously upwards on each side of it into the suspensory ligament.

Coronary ligament The *coronary ligament* is a short but wide process of the peritoneum, which connects the hinder part of the liver to the diaphragm. It reaches all across the liver; though at each side it is enlarged, and forms a triangularly shaped piece; to these larger pieces of it the terms right and left lateral ligaments have been applied.

gives rise to left and *a.* The *left lateral* portion or ligament is attached to the liver above the edge of the left lobe, and is formed by two pieces of peritoneum, which are in contact; it lies in front of the œsophagean opening in the diaphragm.

right lateral ligaments. *b.* The *right lateral* portion or ligament lies deeply in the hypochondriac region, in front of the vena cava inferior. Its two pieces of peritoneum are widely separated from one another, and between them the kidney touches the liver.

MESENTERIC VESSELS AND SYMPATHETIC NERVE.

Examine first vessels to intestine. *Directions.* — The vessels and nerves (mesenteric) that are distributed to the alimentary tube, except to the upper and the lower part, may be first dissected. After these have been examined, and the connections of the aorta and vena cava have been seen, the intestine can be taken out to give

room for the display of the viscera in the upper part of the cavity.

Mesenteric Vessels.—The mesenteric arteries (superior and inferior) are two large visceral branches of the aorta, which supply the whole of the intestinal tube, except the duodenum and the rectum. Each is accompanied by a vein, and by a plexus of nerves of the same name, derived from the sympathetic. Vessels of intestine.

Dissection.—For the dissection of the superior mesenteric vessels and nerves, the great omentum and the transverse colon are to be placed on the margin of the ribs, and one layer (anterior) of the mesentery is to be removed. Whilst tracing the branches of the artery to the small intestine, the student will meet with corresponding veins, and with offsets of the sympathetic nerves on the arteries. Some mesenteric glands and a few lacteal vessels will come into view at the same time. The branches from the right side of the vessel to the large intestine are to be next followed. After all the branches have been cleaned, the trunk of the artery should be traced back beneath the pancreas, and the plexus of nerves surrounding it should be defined. Dissection of superior mesenteric.

The *superior mesenteric artery* supplies branches to the small intestine beyond the duodenal part, and to half the large intestine, viz. as far as the end of the transverse colon. Superior mesenteric artery. Arising from the aorta near the diaphragm, the vessel is directed downwards between the layers of the mesentery, where it forms an arch with the convexity to the left side, and terminates in offsets to the cæcum and the end of the small intestine. Courses to intestine in the mesentery. At first the artery lies beneath the pancreas and the splenic vein; and as it descends to the mesentery it is placed in front of the duodenum and the left renal vein. Connections This vessel is surrounded by the mesenteric plexus of nerves, and is accompanied by the vein of the same name.

Branches.—Whilst the vessel is covered by the pancreas it gives a small branch to that body and the duodenum. and branches. Its other branches are intestinal: those from the left or convex side of the vessel (rami intestinales) supply the jejunum and the ileum; and those from the opposite side supply the colon, and are named colic arteries.

The *pancreatico-duodenal branch* (inferior) is of small Pancreatico-

duodenal. size, and after giving twigs to the pancreas, extends from left to right along the concavity of the duodenum, and anastomoses with the other duodenal branches.

Branches to small intestine. The *intestinal branches* to the jejunum and the ileum, are about twelve in number, and pass from the left side of the artery, between the layers of the mesentery, to their destination. Number and arrangement in arches. About two inches from their origin, or sooner, the branches bifurcate, and the resulting branches unite with similar offsets from the collateral arteries so as to form a series of arches. From the convexity of those arches other branches take origin, which divide and unite in the same way. This process is repeated four or five times between the origin and the distribution of the arteries, but at each branching the size of the vessels diminishes. Distribution on the gut. From the last set of arches, twigs are sent to the intestine; these pass on both aspects of the tube, and anastomose round it, supplying its structure.

Arteries of large gut. The *branches to the large intestine* are three in number, ileo-colic, right colic, and middle colic arteries.

Ileo-colic branch *a.* The *ileo-colic* artery arises from the right side of the mesenteric trunk; it descends to the cæcum, and divides into branches that encircle the head of the colon, as in the tube of the small intestine. A descending offset is distributed to the lower part of the ileum, and to the cæcum ends on cæcum. and the vermiform appendix; whilst an ascending offset supplies the beginning of the ascending colon, and anastomoses with the right colic artery.

Right colic branch supplies ascending colon. *b.* The *right colic artery* is commonly an offset of the preceding, instead of a separate branch from the trunk. Its course is to the right or ascending colon; near this it divides into an ascending and a descending piece, and anastomoses with the ileo-colic artery on the one side, and the middle colic on the other. This artery gives ramifications to the ascending colon.

Middle colic branch passes to transverse colon. *c.* The *middle colic branch* arises from the upper part of the superior mesenteric artery, opposite the transverse mesocolon. Entering between the layers of that fold of the peritoneum, the vessel divides into two large diverging branches: — the right branch anastomoses with the artery to the ascending colon, and the left inosculates on the descending colon with a branch (left colic) of the inferior mesenteric

artery. The intestinal twigs to the transverse colon are supplied from these two divisions, but before entering the gut they are united in arches like those to the small intestine. They form arches before entering intestine.

The *superior mesenteric vein* commences in that part of the intestinal tube to which the artery is distributed, and its radicles unite into one trunk. Thus formed, the vein accompanies the artery beneath the pancreas, and there joins the splenic vein to form the vena portæ. Superior mesenteric vein.

The *mesenteric lymphatic glands* are numerous between the layers of the mesentery, and are lodged in the intervals between the branches of the vessels. Along the large intestine are a few other lymphatic glands, *meso-colic*, which receive the lymphatics of the large intestine. The lactiferous or chyliferous vessels of the small intestine, and the lymphatics of the part of the large intestine supplied by the superior mesenteric artery, pass through the mesenteric glands to reach the thoracic duct. Mesenteric glands receive lymphatics of small, and of part of large intestine.

Dissection. — By drawing the small intestine over to the right side, the dissector will perceive the inferior mesenteric artery on the front of the aorta, a little above the bifurcation of this vessel. The peritoneum should be removed with care from it, and the branches should be traced outwards to the remaining half of the large intestine: a part of the artery enters the pelvis, but this will be afterwards dissected. On the artery and its branches is the inferior mesenteric plexus of nerves. The mesenteric vein is likewise to be followed upwards to its junction with the splenic, or with the superior mesenteric vein. On the aorta the dissector will meet with a plexus of nerves which is to be left uninjured. Dissection of inferior mesenteric.

The *inferior mesenteric artery* supplies branches to the part of the large intestine beyond the transverse colon, and communicating with the superior mesenteric, assists to maintain the chain of anastomosis along the intestinal tube. This vessel is of smaller size than the superior mesenteric, and arises from the aorta from one to two inches above the bifurcation. At first the vessel descends on the aorta, and crosses the left common iliac artery in its course to the pelvis, where it ends in branches to the rectum (superior hæmorrhoidal). The following *branches* are fur- Inferior mesenteric artery. Place of origin. Course and branches.

nished by it to the descending colon and the sigmoid flexure.

Left colic branch to the descending colon.

The *left colic artery* ascends in front of the left kidney, and divides into ascending and descending branches for the supply of the descending colon. By the ascending offset it anastomoses with the middle colic branch of the superior mesenteric artery.

Sigmoid branch to sigmoid flexure.

The *sigmoid artery* is distributed to the sigmoid flexure. Passing almost transversely outwards, it divides into branches, which anastomose above with the preceding colic branch, and below with the hæmorrhoidal. Here, as in the rest of the intestinal tube, arches are formed by the arteries destined for the supply of the intestine.

Branch to rectum.

The *superior hæmorrhoidal artery* enters between the layers of the meso-rectum, and is distributed to the lower part of the great intestine: it will be described in the dissection of the pelvis.

Inferior mesenteric vein.

The *inferior mesenteric vein* begins in the part of the great intestine to which its companion artery is distributed, and ascends along the psoas muscle, away from the artery, to open into the splenic vein beneath the pancreas. Occasionally it joins the superior mesenteric vein.

Veins of intestine without valves.

The mesenteric veins are without valves, and may be injected from the trunk to the branches like an artery.

Lymphatic glands.

Lymphatic glands are found by the side of the descending colon and the sigmoid flexure. The lymphatics from those parts, after passing through the glands, enter the left lumbar lymphatic glands.

Some plexuses of the sympathetic to the viscera.

Sympathetic Nerve. — The following plexuses of the sympathetic, which are derived from the solar plexus beneath the stomach, are in connection with the vessels that are now dissected, viz. superior mesenteric, aortic, spermatic, inferior mesenteric, and hypogastric. The remaining portion of the sympathetic nerve in the abdomen will be subsequently referred to.

Dissection of aortic plexus.

Dissection. — On the two mesenteric arteries the dissector will have made out already the plexuses of nerves that are distributed to the intestinal tube beyond the duodenum: and he has now to trace, on the aorta itself, the connecting nerves between the mesenteric plexuses. By taking the peritoneum from the aorta between the mesenteric vessels,

the aortic plexus will appear: from the upper part of this plexus an offset is to be followed along the spermatic artery; this may be done, on the left side, where the vessel is partly laid bare.

Of hypogastric plexus. By removing the serous membrane from the front of the sacrum, and following downwards, over the iliac arteries, the nerves from the aortic plexus and the lumbar ganglia, the dissector will arrive at the hypogastric plexus of the pelvis.

Superior mesenteric plexus is on artery of same name. The *superior mesenteric plexus* is a large offset on the mesenteric artery and its branches, and is distributed to the same extent of the intestinal tube as the vessel. The nerves surround closely the artery with a sheath, and are covered at first by the pancreas. In the mesentery, near the intestine, some of the nerves leave the arteries, and divide and communicate with others before entering the gut.

Its secondary plexuses. The secondary plexuses are the same as the branches of the artery, viz. intestinal nerves to the small intestine; and an ileo-colic, a right colic, and a middle colic plexus to the large intestine.

Aortic plexus is derived from solar plexus. The *aortic plexus* is the network of nerves covering the aorta below the superior mesenteric artery. Superiorly it is continuous with the solar plexus; and inferiorly it ends on each side in branches, which cross the common iliac artery, and enter the hypogastric plexus of the pelvis. Offsets. From it an offset is furnished to the two visceral branches of the aorta below the renal and superior mesenteric trunks, viz. to the spermatic and inferior mesenteric arteries.

This plexus is best marked on sides of aorta. The aortic plexus is stronger on the sides than on the front of the aorta, in consequence of its receiving accessory branches from the lumbar ganglia, especially the left. At the upper part the plexus seems to be derived from an offset, on each side of the aorta, which is connected with the solar and renal plexuses.

Spermatic plexus. The *spermatic plexus* is formed by an offset from both the aortic and the renal plexus. The nerves from it run on the spermatic artery to the testicle: and in the cord they join other filaments on the vas deferens.

In female. In the female, the nerves on the spermatic (ovarian) artery are supplied to the ovary and the uterus.

Inferior mesenteric plexus.

The *inferior mesenteric plexus* surrounds the trunk and branches of the artery of the same name, and is supplied to the same part of the intestinal tube as the artery is distributed to. This plexus is furnished from the left part of the aortic plexus; and the nerves composing it are whiter and larger than in either of the preceding offsets of the sympathetic. Near the intestine (sigmoid flexure) the branching of the nerves, and the union of contiguous twigs are well marked.

Nerves join like the vessels.

Secondary plexuses.

The following secondary plexuses are named from the arteries they accompany, and are distributed like them to the intestine, viz. the left colic, the sigmoid, and the superior hæmorrhoidal plexus.

Union of the nerves on the intestinal tube.

On the intestinal tube the nerves of one plexus join those of another. Thus the superior mesenteric joins by one end the nerves to the duodenum, and by the other the nerves to the large intestine from the inferior mesenteric plexus. And the inferior mesenteric plexus communicates below with branches to the rectum from the pelvic centre.

Hypogastric plexus.

Situation.

The *hypogastric plexus*, or the large prevertebral centre for the supply of sympathetic nerves to the viscera of the pelvis, is situate in front of the upper part of the sacrum and beneath the peritoneum. It is developed more on each side than in the centre; and the nerves, which are large and flat, have a plexiform arrangement, but without any ganglionic masses on them. By its upper part the plexus receives on each side the termination of the aortic plexus; and it is joined by some filaments from one or two of the upper sacral ganglia. Inferiorly the plexus ends in two parts, right and left, the last being the largest, which are continued forwards with the branches of the internal iliac artery to the pelvic plexuses and the viscera.

In it aortic plexus ends;

and from it offsets are sent to pelvic viscera.

Parts around aorta and cava.

Connections of the Aorta and Vena Cava.—The connections of the *abdominal aorta* and of the *vena cava* may be next looked to, before the viscera are removed from the body.

Dissection to see them.

Dissection.— The part of the abdominal aorta below the origin of the superior mesenteric artery has been laid bare by the previous dissection. To see it higher up, it will be necessary to detach the great omentum from the stomach, without injuring the gastro-epiploïc artery, and after raising

the stomach and the spleen, to remove the peritoneum from the surface of the pancreas. A short arterial trunk (cœliac axis) above the pancreas is not to be cleaned now, otherwise the nerves about it would be destroyed. The vena cava will be dissected at the same time as the aorta.

Aorta lies in middle of spine.

The *aorta* enters the abdomen between the pillars of the diaphragm, and divides into iliac arteries opposite the left side of the fourth lumbar vertebra. At the diaphragm the vessel occupies the middle line of the spine, but it gradually inclines to the left as it descends. In the abdomen the aorta is covered at first by the solar plexus, and by the pancreas and the splenic vein; still lower (beyond the superior mesenteric artery) by the left renal vein and the duodenum; and thence to its termination by the peritoneum and the aortic plexus. The vessel lies on the lumbar vertebræ; and to its right side is the vena cava. Its branches are furnished to the viscera and the wall of the abdomen, but these will be enumerated farther on.

Parts around.

Branches.

Vena cava; extent and connections;

The *vena cava inferior* commences on the right side of the fifth lumbar vertebra by the union of the common iliac veins, and reaches from that spot to the heart. In the abdomen this venous trunk is placed on the right side of the vertebral column; and it and the aorta are concealed by the same parts, as high as the crus of the diaphragm. It lies close to the aorta, as far as the diaphragm, but above that spot it ascends on the right of the crus, and is imbedded in the posterior part of the liver. Lastly, it leaves the abdomen by an aperture in the tendinous centre of the diaphragm, on the right of the aortic opening. The vena cava is joined by some branches from the abdominal viscera, and by others corresponding with the branches of the aorta that are supplied to the parietes of the abdomen.

is by the side of the aorta,

except above.

Branches.

CONNECTIONS OF THE DUODENUM AND PANCREAS.

Directions.— The situation, and the connections of the duodenum and pancreas should be next looked to.

Remove intestine

Dissection.— To see satisfactorily the duodenum and the pancreas, the intestinal tube, beyond the duodenum, is to be removed in the following way: — one ligature is to be placed on the upper part of the jejunum, another on the lower end

of the sigmoid flexure of the colon, and the gut is to be cut through at the points at which it is tied. The detached piece of the intestinal tube can be taken away by cutting through the vessels and the peritoneum that connect it to the wall of the abdomen; after it has been separated, it is to be set aside for examination whilst the body is turned.

to see the duodenum, and pancreas.

To fit the remaining viscera for examination, the student should moderately inflate the stomach and duodenum from the cut extremity of the latter; and whilst cleaning them, he should be careful of the vessels and nerves. On turning upwards the stomach he will be able to trace the pancreas from the spleen on the one hand to the duodenum on the other; and on raising the duodenum, to find the common bile duct between it and the head of the pancreas.

Extent of duodenum; course and situation.

DUODENUM.— The first part of the small intestine, or the duodenum, begins at the small end of the stomach, and, crossing the spinal column, ends on the left side of the second lumbar vertebra. It makes a curve around the head of the pancreas, and occupies the right hypochondriac, right lumbar, and umbilical regions of the abdomen: its peritoneal covering is incomplete and peculiar (p. 511.). From its winding course around the pancreas it is divided into three parts — superior transverse, vertical, and inferior transverse.

Division.

First part is shortest, and is moveable.

The superior transverse part is free and moveable, like the stomach; it measures about two inches in length, and is directed from the pylorus to the neck of the gall bladder, ascending slightly in its progress from the one point to the other. In front it is overlapped by the liver, as well as by the gall bladder when this is distended; and behind it are the bile duct and the vena portæ.

Second part is fixed, and rests on the kidney.

The vertical part is fixed almost immoveably by the peritoneum and the pancreas. It is nearly three inches in length, and descends from the gall bladder as far as the third lumbar vertebra. Superficial to this part is the right bend of the colon, and beneath it are the kidney and its vessels; whilst on its inner side is the head of the pancreas, with the common bile duct. The ducts of the pancreas and liver pour their contents into this piece of the duodenum.

The third part is the longest,

The inferior transverse part is the longest of the three, and is continued across the spinal column to end in the jejunal portion of the small intestine. As it crosses the

spine, it ascends from the third to the level of the second lumbar vertebra, and corresponds with the attachment of the transverse meso-colic fold of the peritoneum, being between its layers; it has the following connections with the parts around: — In front of it are the superior mesenteric vessels with their plexus of nerves; beneath it lie the aorta and the vena cava, with the pillars of the diaphragm, and sometimes the left renal vein is between it and the aorta; above it is the pancreas. and is moveable. Parts around it.

PANCREAS.— The pancreas is situate behind the stomach, and has numerous and complicated connections. Of an elongated form, it extends across the spine from the spleen to the duodenum, and occupies the left hypochondriac, the umbilical, and the right lumbar region of the abdomen. Form and situation of the pancreas.

The gland is covered anteriorly by the ascending layer of the transverse meso-colon, and is in contact posteriorly with the aorta, the vena cava, and the pillars of the diaphragm; it conceals likewise the splenic vein and the commencement of the vena porta. Projecting above the upper border, near the centre, is the arterial trunk of the cœliac axis; to the left of that vessel, along the same border, is the splenic artery, whilst to the right of it are the hepatic artery and the first part of the duodenum. At the lower border, the superior mesenteric vessels emerge opposite the cœliac axis; to the right of that spot is the third part of the duodenum, and to the left of it the inferior mesenteric, ascending to join the splenic vein. The left end or the tail of the pancreas touches the spleen, and is placed over the left kidney. The right extremity or the head is received into the concavity of the duodenum, the two being partly separated behind by the common bile duct, and in front by the pancreatico-duodenal artery: this part projects above and below the body of the gland, like the head of a hammer beyond the handle, and the lower projecting piece is directed to the left along the duodenum as far as the superior mesenteric vessels, beneath which it passes. Its connections by the surfaces, borders, and extremities.

VESSELS AND NERVES OF THE CHYLO-POIETIC VISCERA.

A short branch from the aorta, viz. the cœliac axis, furnishes arteries to the stomach, duodenum, liver, pancreas, Vessels and nerves

of chylopoietic viscera. and spleen ; this subdivides into three chief branches,— coronary, hepatic, and splenic, whose destination is expressed by their names. The veins corresponding with those vessels are collected into one trunk — the vena portæ : and the nerves are supplied from the vagus and the sympathetic trunks.

How to dissect cœliac axis *Dissection.*— The vessels have been in part laid bare by the previous dissection, and the preparation of them will be completed by the removal of the loose tissue and the peritoneum from each. Before beginning this task the student should take care that the liver is well raised ; and whilst completing it he should spare the plexuses of nerves that surround the vessels. and its several branches. Starting from the cœliac axis, he may first follow to the left side the small coronary artery, and clear its branches to the œsophagus and the stomach. Next the hepatic artery, with the vena portæ and the bile duct, may be traced to the liver and the gall bladder ; and a considerable branch of it should be pursued, beneath the pylorus, to the stomach, duodenum, and pancreas. Lastly, the splenic artery, which lies along the upper border of the pancreas, is to be cleaned, and its branches to the pancreas, stomach, and spleen defined. The veins will be dissected for the most part with the arteries, but the origin of the vena portæ is to be made out beneath the pancreas.

This trunk supplies the three following branches :— The CŒLIAC AXIS is the first visceral branch of the abdominal aorta, and arises from that vessel between the pillars of the diaphragm. It is a short thick trunk, about half an inch long, which projects above the upper border of the pancreas, and is surrounded by the nerves of the solar plexus of the sympathetic. Its branches — coronary, hepatic, and splenic,— radiate from the trunk (whence the name axis) to their distribution to the viscera in the upper part of the abdomen.

Coronary, which gives 1. The *coronary artery* is the smallest of the three branches, and passes between the layers of the little omentum to the left orifice of the stomach. At that spot it furnishes some œsophageal branches, and then turns from left to right, along the upper border of the stomach, to anastomose with a branch (pyloric) from the hepatic artery. Its offsets to the œsophagus and the stomach are thus distributed :—

offsets to *a.* The *œsophageal branches* ascend on the gullet through

the opening in the diaphragm, and after supplying that tube, anastomose on it with branches from the thoracic aorta. the œsophagus

b. The *gastric branches* are given to both sides of the stomach as the artery lies along it, and those on the left end communicate with twigs (vasa brevia) of the splenic artery. and to the stomach.

2. The *splenic artery* is the largest branch of the cœliac axis in the adult. It is a tortuous artery, and runs almost horizontally to the left, along the upper border of the pancreas, to the spleen. Near this body it divides into its terminal branches (*splenic*), which are about six in number (from four to ten), and enter the substance of the spleen by the concave surface towards the stomach. In its course the vessel is accompanied by the splenic vein, which is below it, and it distributes branches to the pancreas and the stomach. Splenic artery supplies the spleen,

a. Pancreatic branches.—Numerous small branches are supplied to the gland as the artery lies along it: and one of these, *art. pancreatica magna*, arises near the left end of the gland, and runs to the right, with the duct, in the substance of the viscus. the pancreas by large and small twigs,

b. The *branches for the stomach* arise from the divisions of the artery near the spleen. Some of these, *vasa brevia*, turn upwards to the left end of the stomach, between or beneath the gastro-splenic omentum, and ramify in the coats of that organ. Another branch, *art. gastro-epiploïca sinistra*, which is larger than the others, turns to the right along the great curvature of the stomach, between the layers of the great omentum, and inosculates with the right gastro-epiploïc branch of the hepatic artery. This artery distributes twigs to both surfaces of the stomach, as well as others between the pieces of peritoneum forming the great omentum. and the stomach by vasa brevia; and left gastro-epiploïc.

3. The *hepatic artery* is the largest, in the fetus, of the three branches into which the cœliac axis divides; but in the adult it is intermediate in size between the other two, and is encircled by the largest plexus of nerves. In its course to the liver, the vessel is first bent to the right towards the small end of the stomach, where it supplies its principal branches (superior pyloric and gastro-epiploïc). It then ascends between the layers of the little omentum, on the left side of the bile duct and the vena portæ, and divides Hepatic artery; courses to the liver, in which it ends,

near the transverse fissure of the liver into two large terminal arteries — the right and left hepatic. Its branches are distributed not only to the liver, but freely to the stomach, the duodenum, and the pancreas.

and supplies.

offsets to the stomach.

a. The *superior pyloric branch* descends to the upper border of the stomach, and running from right to left anastomoses with the coronary artery; it distributes small arterial twigs on both the anterior and posterior surfaces of the stomach.

Branches to the stomach, and duodenum, viz.—

b. The *right gastro-epiploïc branch** (art. gast. epiploïca dextra) is a trunk of considerable size, which descends beneath the duodenum near the pylorus, then turns from right to left along the great curvature of the stomach, between the pieces of the great omentum, and inosculates with the left gastro-epiploïc branch of the splenic artery. On the surfaces of the stomach, some offsets are given upwards, and others downwards between the layers of the omentum. It furnishes the following branches to the stomach, and the pancreas and the duodenum: —

inferior pyloric,

Small *inferior pyloric* branches end in the small extremity of the stomach.

and pancreatico-duodenal.

The *pancreatico-duodenal branch* (superior) leaves the trunk opposite the duodenum, and runs along the curve of that intestine, lying between it and the pancreas; it anastomoses below with the pancreatico-duodenal branch (inferior) of the superior mesenteric artery (p. 513.). Both the duodenum and the pancreas receive offsets from this vessel. On the posterior aspect of these viscera is another small artery with a similar position and distribution.

Branches to the liver;

c. The *hepatic branches* sink into the liver at the transverse fissure, and ramify in its substance.

one for the right lobe and gall bladder,

The *right branch* is divided when about to enter the liver at the right end of the transverse fissure, and supplies the following small artery to the gall bladder. The *cystic* artery, on reaching the neck of the gall bladder, divides into two twigs that ramify on the opposite surfaces, and are distributed to the coats.

and one for the left lobe.

The *left branch* is smaller than the other, and enters the liver at the left end of the transverse fissure. A branch to the Spigelian lobe of the liver arises from this division of the artery.

* This artery is named commonly gastro-duodenal as far as to the spot where it gives off the branch to the duodenum and pancreas.

Veins.—The veins of the viscera of this part of the abdomen are three in number, viz. the superior coronary, the splenic, and the portal vein. Three veins, viz.—

The *superior coronary vein* lies along the upper border of the stomach. It begins in the œsophagus and the left part of the stomach, and joins the vena portæ at the pylorus. coronary from the stomach;

The *splenic vein* is of large size, and is formed by the union of branches that issue from the spleen. It takes much the same course as the artery, but is lower than it, and runs beneath the pancreas to the front of the vena cava, where it joins the superior mesenteric vein to form the vena portæ. splenic from the spleen,

Between its origin and termination it receives branches corresponding to the following arteries: vasa brevia, left gastro-epiploïc, and pancreatic; it is also joined by the inferior mesenteric vein about the middle of its length. stomach, and pancreas.

The *vena portæ* conveys to the liver the blood that has been circulated through the following chylo-poietic viscera, viz. the alimentary canal, the pancreas, and the spleen. This vein commences by roots in the viscera above mentioned, like any other vein; but it is deficient in valves, and ramifies through the structure of the liver in the same manner as an artery. Its radicles communicate with small systemic veins on some parts of the intestinal tube, more particularly on the rectum. Vena portæ resembles an artery in its branching.

The vein is formed by the union of the splenic and superior mesenteric veins (p. 515.); and its origin is placed in front of the vena cava, but beneath the pancreas and about two inches from the right end. This vessel is about four inches long, and is directed upwards in the small omentum, behind the bile duct and the hepatic artery, to the transverse fissure of the liver, where it divides into a right and a left branch. Its origin, length, and termination.

In its course it is joined by the coronary or gastric vein, and by the cystic vein near the liver. Accessory branches.

The *right branch* is sometimes joined by the cystic vein, and enters the transverse fissure to ramify in the liver. Terminal branches right and left.

The *left branch* is distributed to the left part of the liver, and gives a small branch to the Spigelian lobe of that viscus.

Bile Ducts. — Two ducts issue at the transverse fissure of the liver, one from each lobe, and unite to form the *common hepatic duct:* the excretory tube, thus formed, is an Common hepatic duct; how formed.

inch and a half long. At its termination it receives the duct of the gall bladder, and by the union of the two the common bile duct is formed.

Common bile duct; The *common bile duct* (ductus communis choledochus), which is formed as above said, is about three inches long:

length and course. it descends almost vertically beneath the upper transverse portion of the duodenum, then between the pancreas and the vertical piece of the duodenum, and opens into this last part of the intestine at the inner side, and above the middle.

Termination. Before piercing the coats of the intestine it is joined commonly by the pancreatic duct, but the two may enter the duodenum separately. Whilst in the small omentum, the duct lies to the right of the hepatic artery, and somewhat before the portal vein.

SYMPATHETIC AND VAGUS NERVES.

General disposition in the abdomen. SYMPATHETIC NERVE. — In the abdomen the sympathetic nerve consists, as in the thorax, of a gangliated cord on each side of the vertebral column; and of prevertebral centres or plexuses, which furnish branches to the viscera.

Two large centres, solar and hypogastric. Two prevertebral plexuses are found in the abdomen. One of these is the solar or epigastric plexus, which is placed behind the stomach, and supplies nerves to all the viscera above the cavity of the pelvis. The other, or the hypogastric plexus, is situate in the pelvis, and distributes nerves to the pelvic viscera. The offsets or the secondary plexuses of these centres accompany the bloodvessels to their destination.

Part to be seen in the abdomen. The visceral part of the sympathetic nerve that remains to be seen, consists of the great epigastric centre, viz. the solar plexus and the semilunar ganglia, with their offsets.

How to lay bare solar plexus. *Dissection.* — To denude the great prevertebral centre above mentioned, the following dissection is to be made: — After the air has been let out of the stomach and the duodenum, the portal vein, the common bile duct, and the gastro-epiploïc artery are to be cut through behind the pylorus; and the stomach, the duodenum, and the pancreas are to be drawn over to the left side. On raising the liver, and taking away some fatty tissue, the vena cava appears: the vein is to be cut across above the junction of the renal

vein with it, and the lower end is to be drawn down with hooks.

Beneath the vein the dissector will find the large reddish semilunar ganglion of the right side. From its inner part he should trace the numerous nerves which form the solar plexus around the cœliac and superior mesenteric arteries; and should unravel the offsets around those arteries, with their secondary plexuses. From the outer part of the ganglion branches are to be traced to the kidney, the suprarenal body, and the diaphragmatic arteries. At its upper part the student may observe the large splanchnic nerve; and deeper than it, one or two other smaller splanchnic nerves, which throw themselves into the solar and renal plexuses. Mixed up with the nerves of the solar plexus are numerous lymphatic glands and a dense tissue, which require to be removed with care. Semilunar ganglia.

The student should then trace the ending of the pneumogastric nerves on the stomach. The left nerve will be found in front near the upper border; and the right nerve will be seen at a corresponding point on the opposite aspect. Branches are to be traced from the right nerve to the plexus of the sympathetic by the side of the cœliac axis, and from the left to the hepatic plexus. Follow the ending of the vagus nerves.

The EPIGASTRIC or SOLAR PLEXUS is the largest of the prevertebral plexuses of the sympathetic, and furnishes nerves to all the viscera of the abdomen above the pelvis. It is a large network of nerves and ganglia, which lies in front of the aorta and the pillars of the diaphragm, and extends from the suprarenal capsule of one side to that of the other. It surrounds the cœliac axis and the superior mesenteric artery, and extends downwards to the pancreas. The plexus is connected on each side with the large and small splanchnic nerves, and it is joined also by some twigs from the right pneumo-gastric nerve. Large offsets are furnished to the different viscera along the vessels. Solar plexus; appearance, extent; gives offsets on blood vessels.

The *semilunar ganglia* of the solar plexus, one on each side, are the largest ganglia in the body. Each is situate at the upper and outer part of the plexus, close to the suprarenal capsule, and on the side of the pillar of the diaphragm. The ganglion on the right side is beneath the vena cava. Irregular in shape, the mass is sometimes oval, and at other Semilunar ganglia; situation; form.

times divided into smaller ganglia. From the outer side nerves are directed to the kidney and the suprarenal capsule, and to the inner side the cords of the solar plexus are connected. At the upper end it is joined by the great splanchnic nerve.

Nerves connected with each.

Several offsets of the plexus.

Offsets of the plexus. — The nerves supplied to the viscera are conveyed on the branches of the aorta, forming plexuses around them; thus there are cœliac, mesenteric, renal, spermatic, and other plexuses. The diaphragmatic artery has also a separate plexus on it.

Plexus to the diaphragm

Diaphragmatic plexus.—The nerves that form this plexus come from the upper and outer part of the semilunar ganglion. They are placed at first on the phrenic artery, but they soon leave it to enter the substance of the diaphragm. A communication takes place between the phrenic nerve of the cervical plexus and these branches of the sympathetic.

has a ganglion on right side.

On the under surface of the diaphragm is a small ganglion where this offset of the plexus joins the spinal nerve, and from it filaments are supplied to the vena cava and the suprarenal body. The ganglion is absent on the left side. — (Swan).

Suprarenal nerves.

The *suprarenal nerves* are very large and numerous, in comparison with the mass supplied, and are directed almost horizontally outwards to the suprarenal body, which they enter at the upper part. One of the splanchnic nerves communicates with this plexus.

Renal plexus

joins spermatic.

The *renal plexus* is derived from the semilunar ganglion, and the outer part of the solar plexus, and it is further joined by one of the two smallest splanchnic nerves. The nerves surround the renal artery, having small ganglia on them, and enter the kidney with the vessels. An offset is given from the renal nerves to the spermatic plexus (p. 517.).

Cœliac plexus

divides like the artery,

The *cœliac plexus* is a direct continuation forwards of the solar plexus around the artery named cœliac axis. It is further joined by the small splanchnic nerve on each side, and by an offset from the right pneumo-gastric nerve. The plexus surrounds the artery, and divides, like it, into three parts — coronary, splenic, and hepatic.

into coronary,

a. The *coronary plexus* accompanies the coronary artery to the upper border of the stomach which it supplies. It communicates with the left vagus nerve, and with the sympathetic on the pyloric artery.

b. The *splenic plexus* surrounds the splenic artery, and is conducted by it to the substance of the spleen. It furnishes offsets, like the artery, to the pancreas, and other nerves to the stomach along the left gastro-epiploïc artery. This plexus is joined by twigs from the left semilunar ganglion, and by an offset from the right pneumo-gastric nerve. splenic,

c. The *hepatic plexus* is continued on the vena portæ, the hepatic artery, and the bile duct to the transverse fissure of the liver, where it enters the liver and ramifies on the vessels. Whilst ascending in the small omentum, the plexus is joined on the left side by offsets from the left vagus and phrenic nerves. — (Swan.) Secondary plexuses are furnished around the branches of the hepatic artery, which have the same name and distribution as the vessels. The following are these plexuses : — and hepatic. The last has these secondary,

A *pyloric* plexus accompanies the pyloric artery to the upper border of the stomach. There are two other plexuses — *gastro-epiploïc* (right) and *pancreatico-duodenal,* corresponding with the branches of the artery : the former meets nerves from the splenic plexus, and the latter communicates with the superior mesenteric plexus on the end of the duodenum. A *cystic* plexus is distributed to the gall bladder with its artery. pyloric, gastro-duodenal, epiploïc, pancreatic, and cystic.

The remaining offsets of the solar plexus, viz. superior and inferior mesenteric, aortic, and spermatic, have been already described (p. 516, 517, 518.); but the derivation of the superior mesenteric and aortic plexuses from the epigastric centre can be now seen.

Ending of the splanchnic nerves.—The *large nerve* perforates the crus of the diaphragm, and generally ends altogether in the semilunar ganglion, but it may give filaments to the renal plexus and the suprarenal body. The *small nerve* comes through the same opening in the diaphragm as the preceding, and ends in the cœliac plexus ; but it enters the renal plexus if the smallest splanchnic nerve is absent. The *smallest nerve*, after piercing the diaphragm, joins the renal plexus. Ending of large splanchnic nerve. small, and smallest.

Ending of the vagus nerve.—In the abdomen the pneumo-gastric nerves end mostly in the stomach. The *left* divides into branches, which extend over the front and along the small curvature of the stomach ; these join the sympathetic, and give offsets to the hepatic plexus. The *right* nerve is distributed to the posterior surface of the stomach near the upper border, and communicates with its fellow, and with the cœliac and splenic plexuses. Ending of left vagus and right.

Prepare for turning the body by removing the viscera. *Dissection.*—The viscera are now to be removed from the abdomen in order that the body may be turned for the dissection of the back, and the other parts. The stomach and the spleen with the duodenum and the pancreas are to be taken away by cutting through the œsophagus near the diaphragm, and dividing the vessels and nerves they receive. The liver is to be also removed by cutting across its ligaments, and dividing the vena cava between its posterior border and the diaphragm. At the same time the right kidney is to be taken out with its suprarenal body; and lastly the dissector should remove the left testicle by cutting through the cord.

Directions for the dissector. *Directions.* — Supposing the body now to be turned for the dissection of the back, and to lie with the face downwards for the usual time, the dissector may examine first the disposition of the fascia lumborum, which is described in the DISSECTION OF THE BACK, p. 409. The rest of the time he should occupy in learning the form and structure of the viscera in the following Section.

SECTION IV.

ANATOMY OF THE VISCERA OF THE ABDOMEN.

THE STOMACH.

Definition. The stomach is the dilated part of the alimentary tube between the œsophagus and the small intestine, into which the masticated food is received to be changed into chyme.

Separate and blow up the stomach. *Dissection.* — To see the form of the stomach this viscus must be blown up moderately, and the surface cleaned; but previously, the spleen is to be detached and the duodenum cut through near the pylorus.

Form, direction, size, divisions. *Form and Divisions.* — The stomach is somewhat conical in form, with the base or wider part turned to the left, and the apex to the right side; and is directed obliquely across the abdomen. Its size varies much in different bodies, and is sometimes much diminished by a constriction in the centre: when it is moderately distended, it is about twelve inches long and four wide. This viscus presents for examination two ends, two orifices, two surfaces, and two borders or curves.

Extremities. — The left end or tuberosity (fundus ventriculi) is the largest part of the stomach, and projects about three inches to the left of the opening of the œsophagus. The right or pyloric end is much smaller than the other, is cylindrical, and forms the apex of the cone, to which the stomach is likened. Left end and right;

Openings. —The left opening (cardiac), which communicates with the œsophagus, is at the highest part of the stomach, and is funnel-shaped towards the cavity of the organ. The right or inferior orifice (pylorus) opens into the duodenum, and is guarded internally by a valve: at the same spot the stomach is slightly constricted externally, where a firm circular ring may be felt. cardiac and pyloric openings; last has a valve.

Surfaces. — The surfaces are somewhat flattened when the stomach is empty, but rounded when it is distended. The parts in contact with the sides have been referred to (p. 502.). Surfaces rounded or flat.

Borders. — The upper border, or small curve of the stomach, is concave towards the left opening, but convex at the opposite end; and the lower border, or large curve, is convex, except near the right end where it is concave: — the concavity of the one border corresponds with the convexity of the other. An arterial arch and a fold of peritoneum (omentum) extend along each border. Upper border; lower border, difference in outline.

STRUCTURE. —In the wall of the stomach are four layers or coats, viz. a serous, a muscular, a fibrous, and a mucous; together with vessels, nerves, and lymphatics. Four strata are in the stomach.

1. *Serous coat.* — The peritoneum gives a covering to the stomach, and is adherent to the surface except at the margins, where an interval exists corresponding with the attachment of the small and the large omentum. In this space are contained the vessels, nerves, and lymphatics of the stomach. During distension of the stomach, the space above mentioned is much diminished. The serous coat is thin and adherent.

2. The *muscular coat* will be laid bare by the removal of the serous covering. It consists of three sets of muscular fibres, viz. longitudinal, circular, and oblique, which lie from without inwards in the order mentioned: the fibres are involuntary or non-striated. The muscular coat is made up of

a. The *longitudinal fibres* are derived from those of the œsophagus; they spread over the surfaces, without entirely longitudinal,

covering them, and are continued onwards to the pylorus and the small intestine. These fibres are most marked along the borders, particularly the smaller one; and at the pylorus they are much stronger than in the centre of the stomach.

circular, *b.* The *circular fibres* form the middle stratum of the muscular coat, and will be best seen by removing the longitudinal fibres near the pylorus. They reach from the cardiac to the pyloric end of the stomach; but at the latter part they are most numerous and strongest, and form a firm ring around the pyloric opening.

and oblique fibres. *c.* The *oblique fibres* are continuous with the circular or deep layer of the œsophagus, and form only part of a layer in the gastric wall. On the left of the cardiac orifice they are seen to arch over the great end of the stomach, and then to spread out on the anterior and posterior surfaces, gradually disappearing on them.

The fibrous coat is thin, but firm. 3. *Fibrous or submucous coat.* — By removing the muscular layer over a small spot, the fibrous coat will appear as a white shining stratum. Formed of areolar or connective tissue, this coat gives strength to the stomach, and serves as a bed in which the larger vessels and nerves ramify before their distribution to the mucous coat. If a small opening is made in this membrane, the mucous coat will project through it, supposing the stomach to be distended with air.

Mucous coat; 4. The *mucous coat* will come into view on cutting open the stomach, but the appearances about to be described can be seen only in a recent stomach.

feel, This coat is a thickish layer, smooth and soft to the touch, which, in the natural and healthy condition, is found colour, of a pale rose colour soon after death. In infancy the natural redness is greater than in childhood or old age; but in the empty state of the stomach the membrane is less vascular than during digestion. When the stomach is confolds, tracted, the membrane is thrown into numerous wavy lines or *rugæ*, which are longitudinal along the great curve, thickness; towards the pylorus. The thickness of the mucous membrane is greatest near the pylorus; and at that spot it forms a fold, opposite the muscular ring, which assists in closing the opendisposition at pylorus. ing. If this membrane and its submucous layer are removed from the pyloric part of the stomach, the ring of muscular fibres (sphincter of the pylorus) will be more perfectly seen.

Microscopic structure of the mucous membrane. — With the aid of a lens the surface of the mucous membrane, when well washed, will be seen to be marked all over by shallow depressions or alveoli, which measure from $\frac{1}{200}$th to $\frac{1}{100}$th of an inch across: these depressions are occupied by the apertures of minute tubes. Generally hexagonal or polygonal in outline, the hollows become larger and more elongated towards the small end of the stomach. Near the pylorus, too, the margins of the alveoli project, and are irregular, so as to resemble rudimentary villi.

On the surface are pits or alveoli; their size, shape, and appearance near pylorus.

By means of a thin section under the microscope, the membrane is seen to be formed almost altogether of minute vertical tubes that lie side by side, and project into the submucous tissue. Measuring from $\frac{1}{500}$th to $\frac{1}{300}$th of an inch across and $\frac{1}{60}$th to $\frac{1}{30}$th of an inch in length, the tubes are closed at the deep end; but they open on the surface of the stomach both in the alveoli, and in the interalveolar spaces. For the most part they are straight, but towards the pylorus they become longer and somewhat sacculated at the deep extremity. In their interior they are lined by columnar epithelium, which becomes spheroidal in the bottom of the tube; and filling them is a colourless fluid, which contains a granular material.

The texture made up of tubes of small size; mostly straight with closed deep end, lined by epithelium; contain fluid.

Over the surface of the mucous membrane small lentiform, *follicles* are scattered, which have a depression in the centre, and correspond with the solitary follicles in the intestine. These are in greatest number near the pyloric end of the stomach, and are most marked in young children.

Follicles,

A columnar *epithelium* covers the surface of the mucous membrane, and enters the small tubes, as before mentioned.*

Epithelial covering.

Bloodvessels and nerves of the stomach. — The different *arteries* of the stomach, after supplying the muscular coat, ramify in the submucous tissue, and terminate in the mucous coat. From that anastomosis in the submucous stratum, small offsets are continued on the tubes to the inner surface of the mucous membrane, where they form a network. The *veins* begin in the mucous membrane

Arteries, veins,

* A thin submucous stratum of muscular fibres has been described as lying on the outer or deeper surface of the mucous membrane throughout the whole alimentary canal. A. T. Middeldorpf, *De glandulis Brunnianis*, 1846. E. Brücke, *Berichte der Wiener Akademie*, 1851.

receive branches from the muscular coat, and deliver their blood into the portal system. Two layers of *lymphatics*, superficial and deep, are found in the stomach. The *nerves* are derived from the pneumo-gastric and sympathetic, as before said, p. 529.

lymphatics, and nerves.

SMALL INTESTINE.

Characters.

The three parts into which the small intestine is divided, viz. duodenum, jejunum, and ileum, have the following differences in their characters: —

Length and fixedness. Width and thickness. Ducts entering it.

The *duodenum* measures about as much as the breadth of twelve fingers, viz. about ten inches, and is more fixed than the rest of the intestinal tube. It is wider in capacity than either the jejunum or the ileum, and its muscular coat is also thicker. Into it the common bile duct and the pancreatic duct pour their contents.

Length. Division arbitrary. Differences at the ends.

The *jejunum* and the *ileum* together are about twenty feet long, and are connected to the mesentery by one border. There is not any perceptible difference between the termination of the one and the commencement of the other, but two-fifths of the length are assigned to the jejunum, and three-fifths to the ileum. At their ends, however, a marked difference may be observed; for the upper part of the jejunum is thicker and more vascular than the lower part of the ileum, and its width is also greater.

Wall has same strata as the stomach.

STRUCTURE. — In the small intestine the wall is formed by the same number of layers as in the stomach, viz. serous, muscular, fibrous, and mucous; and these have the same position from within outwards. The different structures are to be examined on pieces taken from the duodenum, from the upper part of the jejunum, from the lower end of the ileum, and from the middle of the small intestine. After the pieces of intestine have been cut off, they are to be distended with air.

Serous coat like that of the stomach, except in the duodenum.

1. The *serous coat* is closely connected with the subjacent muscular layer. To the greater part of the small intestine (jejunum and ileum) it furnishes a covering, except at the attached part where the vessels enter: at this spot a space exists, resembling that at the borders of the stomach, where the peritoneum is reflected off to form the mesentery. The peritoneum surrounds the duodenum only partly; this peculiarity has been described at p. 511.

2. The *muscular coat* is constructed of two sets of fibres, a superficial or longitudinal, and a deep or circular. The fibres are pale in colour, and are not striated. Muscular coat is formed by a

a. The *longitudinal fibres* will be seen only by a careful removal of the peritoneum, for they are generally taken away with that membrane. They form a thin layer, which is most marked at the free border of the gut. longitudinal

b. The *circular fibres* are much more distinct than the others, and give the chief strength to the muscular coat: they do not appear to form complete rings around the tube of the intestine. and a circular layer.

3. The *fibrous coat* has the same position with respect to other parts as in the stomach, and the same use as the corresponding layer in the viscus. Fibrous coat like that in stomach.

Dissection. — On the removal of a part of the muscular stratum from the jejunum or the ileum, this submucous layer will come into view. Dissect fibrous coat.

In the upper part of the duodenum the student is to seek some small compound glands,— those of Brunner, which are imbedded in the submucous tissue. They lie beneath the mucous membrane, and will be seen shining through the fibrous layer, when the muscular coat has been taken away. Glands of Brunner,

The pieces of intestine may be opened and washed, to show the mucous coat; but the gut should be cut along the line of attachment of the mesentery, so as to avoid Peyer's glands on the opposite side. and mucous coat;

4. *Mucous coat.*— The lining membrane of the small intestine is thicker and more vascular at the beginning than at the ending of the tube, and is marked also by numerous prominent folds (valvulæ conniventes). The surface of the membrane is soft, and is covered with small points (villi) like the pile of velvet. Occupying the substance of the mucous coat are numerous glands; and covering the whole is a columnar epithelium. thickness, folds, and villous surface.

The *valvulæ conniventes* (valves of Kerkring) are permanent folds of the mucous membrane, which are arranged circularly, one after another, along the intestine, and project into the alimentary mass. Crescentic in form, they extend round the intestine for half or two-thirds of its circle, and some end in bifurcated extremities. Larger and smaller folds are met with, sometimes alternating; and the larger Folds or valves; arrangement, length, size and depth;

ones are about two inches long, with two-thirds of an inch in depth towards the centre. Each valve is formed of a doubling of the mucous membrane, which encloses vessels between the layers.

how formed.

Extent on the intestine.

The valves begin in the duodenum, about one or two inches beyond the pylorus, and are continued in regular succession to the middle of the jejunum; but beyond that point they become smaller, and more distant from one another, and finally disappear about the middle of the ileum, having previously become irregular and rudimentary. The valvulæ are largest and most regular beyond, and not far from the opening of the bile duct.

Opening of bile duct; where situate.

The *aperture* of the *common bile* and *pancreatic ducts* is a narrow orifice, from three to four inches from the pylorus, and is situate in a small prominence on the mucous membrane of the duodenum, at the inner and posterior part of the intestine. A probe passed into the bile duct will show the oblique or valvular course (half an inch) through the wall of the intestine. Sometimes the pancreatic duct opens by a distinct orifice.

Sometimes double.

Parts to be learnt in the intestine.

Microscopic structure of the mucous membrane. — With the use of the microscope, and with fresh pieces of intestine, the student will be able to make out the nature of the villi, the several glandular structures, and the epithelium.

The villi cover the surface;

Villi. — When the mucus is washed away from a piece of the lower part of the duodenum, and this is examined in water, the mucous membrane will be found to be studded over very thickly with small projections, which give it the appearance of velvet. Existing along the whole of the small intestine, both on the valves and between them, these bodies are irregular in form, some being triangular, others conical, or cylindrical with a large end. Their length is from $\frac{1}{40}$th to $\frac{1}{20}$th of an inch. They are best marked where the valvulæ conniventes are largest; there their number is estimated at 50 to 90 in a square line, but in the lower end of the ileum at only 40 to 70 over the same surface.—Krause.

their shape, size, and number.

Composition.

Each villus is an extension of the mucous coat, which contains a capillary network of arteries, mostly a single vein, and lacteal vessels. The entire surface of each is invested with columnar epithelium.

Several

Glands. — In the glandular apparatus of the small intes-

tine are included the crypts of Lieberkühn, some solitary glands, and Peyer's and Brunner's glands. Kinds of glands.

The *crypts of Lieberkühn* are minute simple tubes, similar to those in the stomach, though not so closely aggregated, and are found throughout the small intestine. They open on the surface of the mucous membrane by small orifices between the villi, and around the larger glands; but at the opposite end they are closed, and project into the submucous layer. Their length is from $\frac{1}{70}$th to $\frac{1}{50}$th of an inch, and their diameter is $\frac{1}{500}$th of an inch. They are filled with a fluid that contains granules, and are lined by a columnar epithelium. Simple tubes as in the stomach, but not so close; their size and contents.

The *solitary glands* are roundish white eminences, about the size of mustard seed, if distended, which are scattered along the small intestine, but in greatest numbers in the jejunum. Placed on any side of the intestine, or even on or between the valvulæ conniventes, these bodies are covered by the villi of the mucous membrane, and have around them the apertures of the crypts of Lieberkühn. These glands are small sacs, which contain an opaque whitish granular fluid, but are not provided with an aperture into the intestine. Solitary simple glands; size and situation. Closed sacs.

The *glands of Peyer* (glandulæ agminatæ) are found chiefly in the ileum, in the form of oval patches, which measure from half an inch to two inches or more in length, and about half an inch in width. These glands are situate on the part of the intestine opposite to the attachment of the mesentery, and their direction is longitudinal in the gut. Usually they are from twenty to thirty in number. In the lower part of the ileum the patches are largest and most numerous; but they decrease in number and size upwards from that spot, till at the lower part of the jejunum they become irregular in form, and may consist only of small roundish masses. Glands of Peyer; size; situation; number; peculiarities;

A patch, when examined with the microscope, appears to be but a collection of the solitary glands, for it consists of a number of small flattened vesicles or sacs, which are round or oval in form, and are covered by the mucous membrane. Like the glands referred to, the vesicles contain a whitish consistent fluid, and are commonly without any aperture, though they have been found with openings into the intes- Composition of a gland same as that of the solitary glands.

tine. Around the vesicles is a circle of apertures of the crypts before described. The mucous membrane over them is a little hollowed, and may in some instances be furnished with villi. Between the vesicles the lining membrane of the bowel has the same appearance as in other parts.

Compound glands, or Brunner's;

Glands of Brunner.—Directions have been already given how to display these glands (p. 535.). They are small compound glands, similar to the buccal and labial glands of the mouth, which exist only in the duodenum. Near the pylorus these bodies are most numerous, and there they are visible without a lens, being nearly as large as hemp seed. When examined more minutely, the glands are found to consist of lobules, with appertaining little excretory tubes; and each ends on the surface of the mucous membrane by a duct, whose aperture is slightly larger than the mouths of the contiguous crypts of Lieberkühn. In the small secretory cells of the gland the epithelium is laminar.

composition.

Apertures of their ducts.

The epithelium is columnar.

Epithelium. — The epithelial lining of the mucous membrane of the small intestine is of the columnar or cylindrical kind. For the villi it forms a very distinct covering of elongated or prismatic pieces; it sinks also into the crypts of Lieberkühn, and gives them a lining.

How to see the areolar tissue.

Dissection. — To show the connective tissue between the coats of the intestine, a piece of the bowel turned inside out, is to be inflated forcibly; and to ensure the success of the attempt, a few cuts may be previously made here and there through the peritoneal coat. The air enters the wall of the intestine, where the peritoneal covering is wanting, and then spreads through the whole gut; but opposite the solitary glands and the patches of Peyer the mucous coat is more closely connected with the neighbouring structures, and the subjacent portion will not be distended with the air. The intestine may be examined when it is dry.

Arteries;

Vessels of the intestine. — The branches of *arteries* ramify in the submucous layer, and end in small twigs that form a network in the mucous membrane to supply the valves, the villi, and the glands. Opposite the patches of Peyer's glands the intestine is most vascular; and the vessels form circles around the follicles, and supply offsets to them. The *veins* have their usual resemblance to the companion arteries. The *absorbents* consist of a superficial longitudinal set

veins;

absorbents.

(lymphatics), and of a deep transverse set (lacteals), which end in larger vessels in the mesentery. Beneath the patches of Peyer's glands the lymphatics form distinct plexuses.

Structure of the bile duct. — The bile duct consists of a strong fibrous coat, with some muscular fibres, and of an internal or mucous coat. Opening on the surface of the mucous membrane are two sets of glands; one set consists of small single cells collected together, and the other glands have branched tubes. Two coats in the bile duct; glands.

LARGE INTESTINE.

The large intestine is the part of the alimentary canal between the termination of the ileum and the anus. Its divisions, and the connection of these by peritoneum to the abdominal wall have been described (p. 503. 510.). In length this part of the alimentary canal measures about five or six feet, — one fifth of the extent of the whole intestinal tube. The diameter of the colon is largest at the commencement in the cæcum, and gradually decreases from that part, as far as the rectum, where there is, however, a dilatation near the end. Extent of the gut; length; size;

When compared with the small intestine, the colon is found to be distinguished by the following characters: — it is of greater capacity, being in some parts as large again, and is more fixed in its position. The large intestine is also free from convolutions, except in the left iliac fossa, where it forms the sigmoid flexure. Instead of being a smooth cylindrical tube, the colon is sacculated, and is marked by three longitudinal muscular bands, which alternate with as many rows of dilatations or small sacs. Attached to the surface, at intervals, especially along the transverse colon, are processes of peritoneum, containing fat, the appendices epiploïcæ. In the rectum, or the lower part of the large intestine, the surface is smooth, and the bands have disappeared. Compared with small gut, larger, more fixed, not coiled. Sacculated with bands. Appendages. In the rectum.

Dissection. — For the purpose of examining the large intestine the student should select and blow up the cæcum, with part of the ileum entering it; he should prepare also in a similar way a piece of the transverse colon, and a piece of the sigmoid flexure (about four inches of each). The fatty and connective tissues are to be removed with care from each, after it has been inflated. Take pieces of the large intestine.

Definition of cæcum; length and width; receives ileum and appendix.

The CÆCUM, or the head of the colon (caput cæcum coli), is the rounded part of the large intestine which projects, in the form of a pouch, below the junction of the ileum with it. It measures about two inches and a half in length, and, though gradually narrowing inferiorly, the cæcum is the widest part of the colon,—hence the name caput coli. At its inner side it is joined by the small intestine; and still lower there is a small worm-like projection—the vermiform appendix.

Vermiform appendix; attachment; dimensions; It is hollow.

Appendix vermiformis.— This little convoluted projection is attached to the lower and posterior part of the cæcum, of which it was the direct continuation at one period in the growth of the embryo. From three to six inches in length, the appendix is rather larger than a goose-quill, and is connected to the inner part of the cæcum by a fold of peritoneum. It is hollow, and has an aperture of communication with the intestine. In structure it resembles the rest of the colon.

Dry the cæcum, and open it to see the valves.

Dissection. —To study the interior of the cæcum, and the valve between it and the small intestine, the specimen now under examination should be dried. After the cæcum has been dried the following cuts should be made into it: —One oval piece is to be taken from the ileum near its termination; another from the side of the cæcum, opposite the entrance of the small intestine; and lastly the end of the colon included in the ligature is to be cut off.

Situation of the valve; two pieces form it; one ileo-colic, the other ileo-cæcal. These are joined at the ends, and form fræna. Opening

Ileo-cæcal valve.— On looking into the intestine, the ileo-cæcal valve will be seen at the entrance of the ileum into the cæcum. It is composed of two pieces, each with a different inclination, which project into the interior of the cæcum, and bound a narrow, nearly transverse aperture of communication between the two differently-sized parts of the alimentary canal. The upper piece of the valve (ileo-colic) projects vertically into the large intestine, opposite the junction of the ileum with the colon: and the lower piece (ileo-cæcal), which is the larger of the two, has a horizontal direction between the ileum and the cæcum. At each extremity of the opening the pieces of the valve are blended together, and the resulting folds extend transversely for some distance on the intestine, forming the *fræna* or *retinacula* of the valve. The size of the opening in the valve

depends upon the distension of the intestine; for when the cæcum is enlarged, so as to stretch the *fræna*, the margins of the opening are approximated, and may be made to touch. in the valve.

Each piece of the valve is formed by the circular muscular fibres of the intestinal tube, covered by mucous membrane; as if the ileum was thrust obliquely through the wall of the cæcum, after being deprived of its peritoneal coat and its layer of longitudinal fibres. The arrangement above referred to is easily seen, on a fresh specimen, by dividing the peritoneum and the longitudinal fibres, and then gently drawing out the ileum. The valve a prolongation of the wall of the gut.

The *opening of the appendix* into the cæcum is placed below that of the ileum. A small fold of mucous membrane partly closes the aperture, and acts as a valve. Appendix opens into cæcum.

Folds or *ridges* are directed transversely in the interior of the gut, and correspond with the depressions on the outer surface between the sacculi. These eminences result from the doubling of the wall of the intestine, and the largest enclose vessels. Ridges in the cæcum; how formed.

Structure of the Colon.—The coats of the large intestine are the same in number and kind as in the small gut, viz. a serous, muscular, fibrous, and mucous: their relative position to one another is also the same. Four strata in the wall of the gut.

1. *Serous coat.*—The peritoneum does not cover the large intestine throughout in the same degree. It covers the front of the cæcum, and the front and sides of the ascending and descending colon; but in neither does it reach commonly the posterior aspect (p. 510.). The transverse colon is incased like the stomach, and has an interval along both the anterior and the posterior border, at the attachments of the transverse meso-colon and the great omentum. Serous coat differs along the intestine.

2. The *muscular coat* is formed by longitudinal and circular fibres, as in the small intestine, but the former are arranged in bands. Two layers of fibres;

a. The *longitudinal* set of fibres may be traced in the cæcum as a thin layer over all the surface, but they are collected for the most part into three longitudinal bands, each being about half an inch in width. On the vermiform appendix the longitudinal fibres form a uniform layer; and they are continued thence along the cæcum and colon to the rectum, where they are diffused over the surface without longitudinal in three bands: which are spread out on appendix and rectum;

bands. When the bands are divided the intestine unfolds and becomes elongated,—the sacculi and the ridges in the interior of the gut disappearing at the same time.

and circular.

b. The *circular fibres* are spread over the whole surface, but are most marked in the folds or ridges that project into the intestine. In the rectum (to be afterwards seen) they form also the band of the internal sphincter muscle.

Fibrous coat as in small gut.

3. The *fibrous coat* resembles that of the small intestine in every particular. It will be exposed by removing the peritoneal and muscular coverings.

This coat is without folds and villi.

4. The *mucous coat*, which will be seen on opening the intestine, is smooth, and of a pale yellow colour. It is not thrown into special folds, except in the rectum, for the ridges in the interior of the gut are formed by all the coats. The surface is free from villi; and by this circumstance the mucous membrane of the large can be distinguished from that of the small intestine. This difference of the surface in the two portions of the tube is well seen in the ileo-cæcal valve; where the upper surface which looks to the small intestine is covered with villi even to the edge of the opening, whilst the lower surface which is covered by the lining membrane of the cæcum is free from those eminences.

Structure very like that of small gut.

Microscopic appearances.—In a fresh piece of intestine, the mucous membrane will be seen, under the microscope, to possess small tubes or crypts, some larger solitary follicles, and an epithelial covering.

Tubes or crypts more numerous and longer than, those of Lieberkühn.

The *tubules* or crypts occupy the whole length of the large gut, and resemble those of the small intestine, but are more numerous and closer together. Their orifices on the surface are circular, and are more uniformly diffused than the apertures of the crypts in the small gut. A vertical section of the membrane will show the tubes to extend vertically from the surface into the submucous coat, and to be of greater length than the crypts of Lieberkühn in the jejunum and ileum: they measure from $\frac{1}{50}$th to $\frac{1}{40}$th of an inch in length, and $\frac{1}{200}$th to $\frac{1}{120}$th of an inch across.

Simple glands most in the cæcum; size

The *solitary follicles* are found all through the large intestine, scattered here and there; but they are in greatest number in the cæcum, and in the vermiform appendix. They are whitish rounded bodies from $\frac{1}{20}$th to $\frac{1}{10}$th of an inch in diameter, and are situate in the submucous layer amongst

the tubules. These follicular glands are simple sacs with a dilated cavity and a narrow neck opening into the intestine, being in form something like a small rounded fruit with a stalk. and form.

The *epithelium* is of the columnar kind, as it is in the small intestine, and enters the tubules. Epithelium.

Vessels. — The distribution of the vessels in the wall of the large intestine is the same as in the smaller bowel. The absorbent vessels, after leaving the intestine, join the lymphatic glands along the side of the colon. Vessels and nerves o the gut.

THE PANCREAS.

The pancreas is a narrow flattened gland about seven inches in length, which has some resemblance to a dog's tongue. It is larger at the right than at the left end; and is divided into a head, tail, and body. Form and length; divisions.

The *head*, or the right extremity, occupies the concavity of the duodenum; whilst the left extremity, or the *tail*, is rounded, and touches the spleen. The *body* of the gland is narrowest a little to the right of the vertebral column, and is thickest at the upper border; it measures about one inch and a half in breadth, and from half an inch to an inch in thickness. Its connections with surrounding parts are described at p. 521. Situation and form of the head, of the tail, and of the body.

Dissection. — Let the pancreas be placed on the anterior surface, and the excretory duct contained in its substance be traced posteriorly from right to left. The duct will be recognised by its white colour. Trace out the duct.

Structure. — The pancreas is a compound gland, and is provided with a special duct. It is destitute of a distinct capsule, but it is surrounded by connective tissue, which projects into the interior, and connects together the lobules. The fluid secreted by it assists in the digestion of the aliment. It is a compound gland, without a distinct capsule.

The glandular structure is soft and loose in texture, and is of a reddish, or grayish white colour. It consists of lobules, which are united into larger masses by connective tissue, vessels, and ducts. In analysing a lobule it will be found to consist ultimately, as in the parotid, of the branchings of the excretory duct, which end in closed vesicular extremities, and are surrounded by a plexus of vessels. Texture and colour; constitution like the salivary glands.

The duct of the gland; extent; branches; termination; size and structure.

The *duct* of the pancreas (canal of Wirsung) extends the entire length of the gland, and is somewhat nearer the lower than the upper border. It begins in the tail of the pancreas, where it presents a bifurcated extremity; as it continues onwards to the head of the gland, it receives many branches, and it finally ends by opening into the duodenum, either in union with, or separate from the common bile duct (p. 536.). Of the tributary branches the largest is derived from the head of the pancreas. The duct measures from $\frac{1}{15}$th to $\frac{1}{10}$th of an inch in diameter near the duodenum, and is formed of a *fibrous* and a *mucous* coat: the latter is lined by a cylindrical *epithelium*, and is provided with small compound glands in the duct and its largest branches.

Peculiarities;

Occasionally there are two pancreatic ducts: or the branch from the head of the pancreas may open separately into the duodenum, one inch or more from the chief duct.

Vessels and nerves.

Vessels and nerves.—The arteries and veins have been described already: and the lymphatics join the lumbar glands. The nerves are furnished by the solar plexus.

THE SPLEEN.

Consistence and colour of the spleen; use;

The spleen is a vascular spongy organ of a bluish or purple colour, sometimes approaching to gray: it has but slight consistence, so that the texture is friable, and easily broken under pressure. The use of the spleen is unknown.

form; position; surfaces; borders; ends.

The viscus is somewhat elliptical in shape, and is placed vertically against the great end of the stomach, as before described (p. 506.). At the outer aspect it is convex towards the ribs. On the inner aspect the surface is marked by a longitudinal ridge, nearer the posterior than the anterior border, into which the vessels plunge to ramify in the interior; whilst before and behind that ridge, the surface is flattened or somewhat hollowed. The spot where the vessels enter is named the hilus of the spleen. The anterior border is thinner than the posterior, and is often notched. Of the two extremities, the lower is more pointed than the upper.

Size

The size of the spleen varies much. In the adult it measures commonly about five inches in length, three or four inches in breadth, and one or one inch and a half in thick-

and weight.

ness. Its weight lies between four and ten ounces, and is rather less in the female than in the male.

Sometimes accessory spleens.

Small masses or *accessory spleens* (splenculi) are often found near the fissure of the spleen, in the gastro-splenic omentum, or in the great omentum. Varying in size from a bean to a moderate sized plum, these bodies are commonly one or two in number; but they may be many more. In one instance they exceeded even a score.

Two coats and special material in the spleen.

Structure.—Enveloping the spleen are two coverings, a serous and a fibrous. The mass of the spleen is formed by a network of fibrous tissue, which contains in its meshes the proper splenic substance, and the Malpighian corpuscles. Throughout the whole mass the bloodvessels and the nerves ramify. No duct exists in connection with this organ.

Serous coat nearly complete.

1. The *serous* or *peritoneal coat* incases the spleen, covering the surface, except at the hilus and the posterior border of the viscus. It is closely connected to the subjacent fibrous coat.

Fibrous coat sends inwards processes.

2. The *fibrous coat* (tunica albuginea) gives strength to the organ, and forms a complete case for it. At the fissure on the inner surface, this investment enters the interior of the spleen with the vessels, to which it furnishes sheaths. If an attempt is made to detach this coat, numerous fibrous processes will be seen to be connected with the inner surface.

Fibres that form it.

Its colour is whitish; and its structure is made up of connective and elastic tissues. In certain animals some muscular fibres are said to be present in it.

Interior of spleen,

Dissection.—The spongy structure will come into view, by washing and squeezing a piece of fresh (bullock's) spleen under water, so as to remove the grumous looking material.

and disposition of fibrous tissue in it.

The *trabecular tissue* forms a network through the whole interior of the spleen, similar to that of a sponge, which is joined on the one hand to the external casing and on the other to the sheaths around the vessels.

To form an areolar structure.

The fibrous processes are white, flattened or cylindrical, and average from $\frac{1}{100}$th to $\frac{1}{30}$th of an inch: they consist of fibrous and elastic tissues. In animals muscular fibres are described as existing in the processes (Kölliker). The interstices between the fibres communicate freely together, and contain the proper substance of the spleen, and the vessels.

Parts seen with microscope. *Microscopic appearances.* — The characters of the substance of the spleen and of the Malpighian bodies must be made out with the aid of the microscope.

Splenic substance; colour, and cells. The *splenic pulp* is a soft semi-fluid red-brown mass, which fills the areolæ of the interspersed white trabecular structure. Under the microscope this material is composed of very fine fibres and bloodvessels, with special cells, and small masses of blood undergoing transformation into pale nucleated cells (Kölliker).

Cells of spleen-pulp. The special cells are united by a reddish-yellow fluid, and form the half of the pulpy substance: they are of different sizes, apparently as if in different stages of growth, the smallest being nucleus-like bodies, and the largest are pale one or two nucleated and granular cells.

Malpighian bodies; The *Malpighian corpuscles* are best seen in the human body after sudden death, or in children. They are small size; vesicular bodies, averaging $\frac{1}{60}$th of an inch in diameter, and are appended, mostly without pedicles, to the sheaths of the smallest branches of the arteries; they project into the pulp attachment; of the spleen, and are surrounded by it except at the attached side. Each is a closed sac, having a membranous case, with contents.

constituents. The coat of the corpuscle is transparent, and is said to consist of the same tissue as the sheaths of the small arteries with which it is continuous (Kölliker). In the interior is a tenacious whitish albuminous mass, with different sized pale cells, being granular as well as nucleated, of the same nature as those in the spleen-pulp.

Splenic artery *Bloodvessels.* — The branches of the *splenic artery* enter the spleen, and their ramifications are surrounded by the supplies corpuscles of spleen. sheaths of tissue, even to the terminal twigs. The chief branches are said not to join together; and they accompany the veins till they have a size from $\frac{1}{100}$th to $\frac{1}{20}$th of an inch. Then they leave the veins, and, still surrounded by sheaths, end in the smallest branches; these pass by the Malpighian bodies, supplying fine twigs to them which ramify in their interior, and then end by means of tufts of offsets in the splenic pulp. Vein begins by capillaries. The *splenic vein* begins in the capillaries occupying the splenic pulp in the intertrabecular spaces, as in other parts of the body, and without dilatations (Kölliker). The branches of veins are much larger than the arteries

which they accompany to the fissure of the spleen; and in their course they receive accessory branches, some joining at a right angle.

Nerves and lymphatics.—The *lymphatics* are superficial and deep, and enter the glands in the gastro-splenic omentum; their arrangement in the spleen is unknown. The *nerves* come from the solar plexus, and surround the artery and its branches; according to Ecker they end in free dichotomous points by the sides of the arterial tufts. Lymphatics. Nerves.

THE LIVER.

The liver secretes the bile, and is the largest gland in the body. Its duct opens into the duodenum with that of the pancreas. Office of the liver.

Dissection.—Preparatory to examining the liver, the vessels at the under surface should be dissected out. This proceeding will be facilitated by distending the vena portæ with cotton wool, and the gall-bladder with air through its duct. The several vessels and ducts are then to be defined, and the gall-bladder to be cleaned. On following outwards the left branch of the vena portæ to the longitudinal or antero-posterior fissure, it will be found connected anteriorly with the remains of the umbilical vein, and posteriorly with the remains of the ductus venosus. Clean the vessels on the under surface.

The *liver* is of a red-brown colour and firm consistence; and weighs commonly in the adult from three to four pounds (fifty to sixty ounces). Transversely the gland measures from ten to twelve inches; from front to back between six and seven inches; and in thickness, at the right end, about three inches, but this last measurement must change with the spot examined. Colour, and consistence; weight, measurements.

In its shape the liver is somewhat square; and in form it differs at the surfaces, borders, and extremities; it is also marked by several lobes and fossæ, and by fissures which contain vessels. The ligaments and the connections of the liver are described at p. 505. 511. Form and divisions.

Surfaces.—On the upper aspect the liver is convex: extending from front to back is the suspensory ligament, which divides the upper surface into two unequal parts, of which the right is the larger. The under surface is irregular, and presents lobes, fissures, and fossæ. In contact with this sur- Upper surface smooth; under surface irregular.

face is the gall-bladder; and a longitudinal fissure divides it into a right and a left lobe.

Anterior border is thin and notched,

Borders.—The anterior border is thin, and is marked by two notches: one is opposite the fissure on the under surface before alluded to, and the other corresponds with the edge of the gall-bladder. The posterior border is much thicker at the right end than at the left, and in that part it touches the kidney and the diaphragm. Opposite the vertebral column is a hollow in this border; and the vena cava is partly imbedded in the substance of the liver on the right of that spot.

posterior is thicker, and also notched.

Extremities.

Extremities.—The right part of the liver is thick and rounded, but the left is thin and flattened.

Lobes are on under surface, and are five, viz.

Lobes.—On the under surface the liver is divided primarily into two lobes, a right and a left, by the longitudinal fissure that passes from before backwards; and connected with the right lobe, on its under surface, are three others, viz. the square lobe, the Spigelian lobe, and the caudate lobe.

left,

The left lobe is smaller and thinner than the right, and has a slight depression inferiorly where it touches the stomach.

right; last subdivided into

The right lobe forms the greater part of the liver, and is separated from the left by the longitudinal fissure on the one aspect, and by the suspensory ligament on the other. To it the gall-bladder is attached; and the following lobes are projections on its under surface.

square,

The square lobe (lobulus quadratus) is situate between the gall-bladder and the longitudinal fissure. It reaches anteriorly to the margin of the liver, and posteriorly to the fissure (transverse) by which the vessels enter the interior of the viscus.

Spigelian,

The Spigelian lobe lies behind the transverse fissure, and forms a roundish projection on the surface. On its left side is the longitudinal fissure, and on its right, the vena cava inferior.

and caudate lobe.

The caudate lobe is a slight elongated eminence, which is directed from the Spigelian lobe behind the transverse fissure, so as to form the posterior boundary of that sulcus. Where the fissure terminates, this projection subsides in the right lobe.

Three]

Fissures.—Extending horizontally half across the right

part of the liver, between the Spigelian and caudate lobes on the one hand, and the square lobe on the other, is the transverse or portal fissure. This fissure or *hilus* is nearer the posterior than the anterior border of the liver, and contains the vessels, nerves, ducts, and lymphatics of the viscus. At its left end, it is united at a right angle with the longitudinal fissure. fissures, viz. portal, or transverse,

The longitudinal fissure extends from the front to the back of the liver between the right and left lobes. In the part anterior to the transverse fissure (fissure for the umbilical vein) is the remnant of the umbilical vein, which is called round ligament, and is oftentimes arched over by a piece of the hepatic substance (pons hepatis). In the part behind the transverse fissure (fissure for the ductus venosus) is a small obliterated cord that remains from the ductus venosus of the fœtus. longitudinal;

The fissure or groove for the vena cava is placed on the right side of the Spigelian lobe, and is frequently bridged over by the liver. If the cava be opened, the large hepatic veins will be seen entering it. one for the vena cava.

Fossæ. — On the under surface of the right lobe are these depressions: one for the gall-bladder, to the right of the square lobe; another for the colon, near the anterior part; and a third for the kidney, near the posterior part. Fossæ beneath.

Vessels of the transverse fissure.— The vessels lying in the transverse fissure, viz. vena portæ, hepatic artery, and duct, have the following disposition :— the duct is anterior, the portal vein posterior, and the artery between the other two. Vessels in the transverse fissure;

Hepatic duct. — The duct that conveys away the bile, is formed by two branches; these issue from the liver, one from each lobe, and are soon blended in a common tube or hepatic duct. After a distance of one inch and a half, the hepatic duct is joined by the duct of the gall-bladder; and the union of the two gives rise to the common bile duct. The *hepatic artery* is divided into two, one for each lobe, and its branches are surrounded by nerves and lymphatics. The *vena portæ* branches, like the artery, into two trunks for the same lobes, and gives an offset to the Spigelian lobe: its left branch is the longest. situation and branching.

Fœtal condition of the umbilical vein.— In the longitudinal In the longitu-

dinal fissure in the fœtus, fissure are the remains of a vessel which has the undermentioned arrangement in the fœtus. Before birth the large *umbilical vein* occupies the longitudinal fissure, and opens posteriorly into the vena cava; and the part of the vessel beyond the transverse fissure receives the name *ductus venosus.* Branches are supplied from the vein at that period to both lobes of the liver, and a large one, which is directed to the right lobe, is continuous with the left division of the vena portæ.

condition after birth. After birth the anterior part of the umbilical vein is closed, and becomes eventually the round ligament: and the posterior part, or the ductus venosus, is also obliterated, only a thin cord remaining in its place; whilst the lateral branches, which are in a line with those of the vena portæ, remain open, and subsequently form part of the portal system of vessels. Occasionally the ductus venosus is found more or less pervious.

Glandular structure is incased by two coats. STRUCTURE OF THE LIVER.— The substance of the liver consists of a collection of small secreting bodies, called lobules or acini; together with a large proportion of vessels, which are concerned both in the production of the secretion and in the nutrition of the organ. The whole is surrounded by a fibrous and a serous coat.

Serous coat, 1. *Serous coat.* — The peritoneum invests the liver almost completely, and adheres closely to the subjacent coat. At where deficient. certain spots, intervals exist between the two, viz. in the fissures occupied by vessels, at the lines of attachment of the ligaments, and at the surface covered by the gall-bladder. Where the right lateral ligament is inserted the space is the largest.

Fibrous covering is prolonged to the interior. 2. The *fibrous covering* is very thin, but it is rather stronger where the peritoneum is not in contact with it. It invests the liver, and is continuous at the transverse fissure with the fibrous sheath (capsule of Glisson) surrounding the vessels in the interior of the hepatic mass. When the membrane is torn from the surface, it is found to be connected with fine shreds, that dip between the lobules or the glandular structure of the liver.

Lobules of the liver; *Size and form of the lobules.* — The lobules constitute the proper hepatic substance, and can be seen either on the exterior of the liver, or on a cut surface, or by means of a rent

of the mass. As thus observed, these bodies are about the size of a pin's head, and measure from $\frac{1}{20}$th to $\frac{1}{10}$th of an inch in diameter. Closely massed together, each presents a dark central point, and is isolated from the surrounding ones by a stratum of connective tissue. By means of transverse and vertical sections of the lobules, their form will appear triangular on the exterior, but five or many sided in the interior of the liver. They are clustered around the smallest divisions (sublobular) of the hepatic vein, to which each is connected by a small twig issuing from the centre (intralobular vein), something like the attachment of the lamina to the stalk or petiole of a leaf. The part of each lobule in contact with the small sublobular vein, wants the covering of areolar tissue that invests the other sides.

size and appearance; form and investment.

To study the minute structure of these secretory elements of the hepatic substance, the student should have the different vessels of the liver minutely injected, and should be provided with a microscope.

Difficult to study lobules.

Constituents of the lobules.— Each lobule or elementary piece of the liver is composed of hepatic secretory cells, which are arranged in lines so as to leave intervals between them; and is provided with a capillary network of vessels, and with radicles of an excretory duct.

A lobule is a distinct gland.

Cells of the lobules. — The hepatic or *biliary* cells are seen to be of an irregular form under the microscope, being rounded or flattened, elongated, or many sided; and to possess a bright nucleated nucleus, or even more than one. In size they vary from $\frac{1}{1080}$th to $\frac{1}{840}$th of an inch; they are of a yellowish colour, and enclose a half fluid substance, probably the elements of the bile, together with fatty and yellow colouring particles. These nucleated cells adhere together by their surfaces so as to form rows, with spaces between them, which radiate from the centre to the circumference: and this linear arrangement is oftentimes less regular at the outer third of the lobule. The cells are connected with the origin of the ducts, and are concerned in the secretion of the bile.

Biliary cells of the lobule. Situation and form; size and contents; connection with ducts.

Arrangement of the vessels. — The disposition of the several vessels is the following: The smallest branches of the *vena portæ*, after uniting in a circle around the lobule, where they are named interlobular, enter its substance, and

Arrangement of its vessels, viz. vena portæ,

form therein a network of capillaries near the circumference. The *hepatic vein* occupies the centre of the lobule, and its radicles communicate with the portal plexus; it issues from the base of the lobule as the intralobular vein. The *radicles* of the *bile duct* are supposed to form a plexus in the lobule; connected with these are the secretory hepatic or biliary cells that produce the bile. The roots of the bile duct leave the lobule at its circumference, and are joined in an interlobular plexus outside it, like the portal vessels.

(hepatic vein, and bile duct.)

Use of the vessels. From the facts above stated respecting the arrangement of the vessels, it appears that the portal capillaries conduct the blood from which bile is secreted; that the hepatic vein carries back the superfluous blood; and that the secreted bile is conveyed away by the branches of the biliary duct.

Arrangement of vessels in the liver. VESSELS OF THE LIVER.—Two sets of vessels ramify in the liver: — One set, concerned in the secretion and the nutrition of the organ, enters the transverse fissure, and is directed transversely in spaces named portal canals, where it is enveloped by areolar tissue, the capsule of Glisson. The other set, or the hepatic veins, is without a sheath, and runs from the anterior to the posterior border of the liver: it conveys to the vena cava the blood that has been circulated through the organ. The ramifications of these different vessels are to be traced in the liver.

Capsule of Glisson, with vessels in transverse fissure: investing sheath extends to the lobules. The *capsule of Glisson* is a layer of areolar tissue, that envelopes the vessels entering the liver through the transverse fissure. In this sheath the vessels ramify, and in it they are minutely divided before their termination in the lobules. Processes of the sheath accompany the small interlobular vessels, and join the covering of the lobules. If a transverse section is made of a portal canal, the vessels will retract somewhat into the loose surrounding tissue.

Vena portæ occupies portal canals, and supplies vaginal and in- The *vena portæ* ramifies in the liver like an artery, and the blood is circulated through it in the same manner, viz. from trunk to branches. After entering the transverse fissure the vein divides into primary branches; these lie in the portal canals or spaces with offsets of the hepatic artery, the hepatic duct, and the nerves and lymphatics. The same division is repeated again and again; and the resulting vessels give off minute lateral branches, some of which, *vaginal*, ramify in the loose sheath before their final distribution to the hepatic substance, whilst others pass to the lobules without previous anastomosis. Finally, the last branches of the

vein penetrate between the lobules, around which they form a circle, and then end in the interior as before explained: where these twigs lie between the lobules they are named *interlobular*. terlobular branches.

Hepatic duct. — The commencement of the duct within the lobules is uncertain; but probably the duct has a reticular arrangement amongst the portal vessels, its radicles corresponding to the spaces between the rows of cells, and being lined by a thin membrane. On leaving the lobules the branches form a plexus, *interlobular*, between them; and the small ducts soon unite into larger *vaginal* branches, that lie in the portal canals with the other vessels. Lastly, the ducts are collected into a right and a left trunk, which leave the liver at the transverse fissure as before described. Bile duct.

Ducts have been found in the left lateral ligament of the liver, between the layers of the peritoneum; they anastomose together and are accompanied by branches of the vessels of the liver, viz. vena portæ, hepatic artery, and hepatic vein. Some ducts in the lateral ligament.

The *hepatic artery* is consumed in the nutrition of the structure of the liver. Whilst surrounded by the capsule of Glisson it furnishes *vaginal* branches to that sheath, which ramify in it and give it a red appearance in a well injected liver; it supplies other twigs to the coats of the vena portæ and the biliary duct. From the vaginal branches some few offsets are sent to the lobules to supply their structure. This artery is supposed by Mr. Kiernan to terminate in venous capillaries that communicate with the branches of the vena portæ. Hepatic artery nourishes the liver, and joins vena portæ.

The *hepatic veins* (venæ cavæ hepaticæ) begin by a plexus in the interior of each lobule, and from it an *intralobular* vein issues at the base; these join together and form still larger or *sublobular* branches. The next sized branches cease to receive any intralobular twigs, and merely unite with neighbouring branches to produce larger veins. Finally, the hepatic veins are collected into large trunks, that are directed from before backwards to the vena cava inferior, into which they open by large orifices. The venæ cavæ hepaticæ may be said to be without a sheath, for this is very slight only in the larger trunks: so that when they are cut across the ends remain patent in consequence of their close connection with the hepatic structure. Hepatic veins without a sheath begin in the lobules, and end in the vena cava.

THE GALL-BLADDER.

The gall-bladder is the receptacle of the bile, and is situate in a depression on the under surface of the right lobe of the liver, to the right of the square lobe. Conical in form, or pear-shaped, its larger end (*fundus*) is directed forwards Use and situation; form;

beyond the margin of the liver; whilst the smaller end, or the neck, is turned in the opposite direction, and bends downwards to end in the cystic duct by a zigzag part. In length the gall-bladder measures three or four inches, and in breadth rather more than an inch at the fundus, or the widest part. It holds rather more than an ounce. By one surface the sac is in contact with the liver, and on the opposite it is covered by peritoneum. The larger end touches the abdominal wall opposite the tip of the cartilage of the tenth rib, and is contiguous to the transverse colon; and the small end touches the duodenum.

size; connections;

Structure of wall.

Structure. — The wall of the gall-bladder has a peritoneal, a fibrous and muscular, and a mucous coat, with thin intervening layers of connective tissue.

Serous coat.

The *serous coat* is stretched over the under or free aspect of the gall-bladder, and surrounds the large end when the viscus is distended.

Fibrous and muscular stratum.

The *muscular coat*, which has not great strength, gives a complete covering to the sac, and has much areolar tissue intermixed with it.

Mucous layer is areolar on surface,

The *mucous coat* is marked internally by numerous ridges and intervening depressions, which give an areolar or honeycomb appearance to the surface. On laying open the gall-bladder this condition will be seen, with the aid of a lens, to be most developed about the centre of the sac, and to diminish towards each extremity. In the larger hollows, there are other smaller depressions which lead to mucous follicles. The surface of the mucous membrane is covered by a columnar epithelium.

and covered by a columnar epithelium.

Projections of the wall.

Where the gall-bladder is bent, at its junction with the cystic duct, its coats project into the interior, and give rise to ridges that resemble the parietal septa in the sacculated large intestine.

Duct of gall-bladder.

The *cystic duct* joins the hepatic duct at an acute angle, to form the ductus communis choledochus. It is about an inch and a half long, and is distended and somewhat sacculated near the gall-bladder.

Structure same as sac, and is provided with glands.

Structure.— The coats of the duct are the same as those of the sac from which it leads, but the muscular fibres are very few. The mucous lining is provided with branched glands, as in the hepatic and common bile ducts (p. 539.).

But in the hepatic ducts the glands are arranged in a row on each side.

Valve of the gall-bladder. — On slitting open the duct the mucous membrane is seen to form a series of semilunar projections (from nine to twenty), which are arranged obliquely around the tube, like the thread of a screw, and increase in size towards the gall-bladder. This structure is best seen on a gall-bladder that has been inflated and dried; as in this state the parts of the bladder between the folds are most distended, giving rise to the sacculated appearance. Mucous coat like a screw,

Bloodvessels and nerves. — The vessels of the gall-bladder are named cystic; the *artery* is a branch of the hepatic, and the vein opens into the vena portæ near the liver. The *nerves* are derived from the hepatic plexus, and entwine around the vessels. The *lymphatics* follow the cystic duct, and join the deep lymphatics on the spinal column. Artery, and vein, nerves, and lymphatics.

THE KIDNEY AND THE URETER.

The organ for the secretion of urine has a characteristic form: flattened on the sides, it is larger at the upper than at the lower extremity, and is hollowed out at the inner part of its circumference. For the purpose of distinguishing between the right and left kidneys, let the excavated margin be supposed to be turned to the spinal column, whilst the ureter, or the excretory tube, is kept more posterior than the other vessels; and let that end be directed downwards, towards which the ureter is naturally inclined. Use and form. To distinguish right from left.

With the special form above mentioned, the kidney is of a deep red colour, and presents an even surface. Its average length is about four inches, its breadth two, and its thickness about one inch; but the left is commonly longer and more slender than the right kidney. The usual weight of this body is about five ounces and a half in the male, and rather less in the female. Colour, size, and weight.

The upper extremity of the kidney is rounded, is thicker than the lower, and is surmounted by the suprarenal body; the lower end is flat, and more pointed. The relative position with respect to the spinal column has been before detailed (p. 506.). On its anterior aspect the kidney is convex, but on the opposite surface it is flattened. The outer border is convex; but the inner is excavated, and is Extremities; surfaces; borders.

marked by a longitudinal fissure, *hilum.* In the interior of the kidney is a hollow, named *sinus,* into which the hilum leads, and in which the vessels and the duct are contained before they pierce the renal substance.

Contents of the fissure; their position. In the fissure of the kidney the several vessels are thus placed with respect to one another: — The divisions of the renal vein are in front, the ureter is behind, and the branches of the artery lie between the other two. On the vessels the nerves and lymphatics ramify, and connective tissue and fat surround the whole.

Open the kidney, and clean vessels. *Dissection.* — To examine the interior it will be necessary to cut through the kidney from the inner to the outer border, and to remove the loose tissue from the vessels, and the divisions of the excretory duct that enter the hilum. The hollow, or sinus, that contains the bloodvessels, now comes into view.

Renal substance divided into cortical and pyramidal. The *interior of the kidney* appears on a section to consist of two different materials, viz. of an external granular or cortical part: and of internal, darker coloured, pyramidal masses, which converge towards the centre, and are connected with the divisions of the excretory duct. But it will subsequently appear that each of these parts is constructed of the same elements, though somewhat differently arranged.

Extent of cortical substance; colour: consistence; composition. The *cortical substance,* or the external part, forms about three-fourths of the kidney; it covers the pyramidal masses with a layer about two lines in thickness, and sends prolongations between the same nearly to their extremities. Its colour is of a light red, unless the kidney is blanched; and its consistence is so slight that the mass gives way beneath the finger. This layer is formed of a congeries of convoluted uriniferal tubes, surrounded by vascular plexuses; and, in a well-injected specimen, red points (Malpighian bodies) are scattered here and there through its texture.

Pyramids; number, form, and direction end in papillæ. The *pyramidal masses* (pyramids of Malpighi, medullary substance,) are twelve or eighteen in number, and converge to the sinus of the kidney. Each mass is conical in form: it has the base turned towards the circumference of the organ, where it is surrounded by the cortical substance; and the apex, which is free from cortical covering, directed to the hollow at the inner part of the kidney. At this last spot it ends in a smooth, rounded part, named *mamilla* or *papilla,*

and is surrounded by one of the divisions (calyx) of the excretory tube. Occasionally two of the masses are united in one papillary termination. This portion of the kidney is denser than the cortex, its colour is darker, and its cut surface has a grooved appearance. The conically-shaped mass is constructed of uriniferal tubes, like the cortical covering; but in it the tubes have become straight, and are converging to their termination on the papilla. If the mass is compressed, urine will exude from the tubes, through apertures in the apex.

Physical characters; composition.

In the human fœtus, and in some animals, the kidney is divided into separate lobes; and each lobe consists of a pyramidal mass, with a cortical envelope. With the growth of the human kidney the original divisions disappear, and the cortical covering of contiguous lobes is blended to produce the interlobular cortical part. But in the adult the uriniferous tubes and the vessels of each pyramid and its envelope, which correspond with one of the primary lobes, are distinct as in the organ in its lobular condition.

Rudimentary condition of the kidney.

STRUCTURE OF THE KIDNEY.—The substance of the kidney consists of a mass of minute secretory tubes, intermixed with bloodvessels, lymphatics, nerves, and fine connective tissue. The whole is incased by a fibrous coat.

Secretory tubes are incased by a fibrous coat.

The *fibrous coat* is a white firm case, which is connected with the renal tissue by fine processes and vessels, but is readily detached from it by slight force. At the inner margin of the kidney it sinks into the hollow or sinus, and sends processes on the entering vessels: at the same spot it is continuous with the fibrous coat of the excretory duct.

Fibrous coat sends in offsets.

To obtain a knowledge of the anatomy of the secreting tubes, and to make out the disposition of the bloodvessels, the dissector will require a microscope and good fine injections of the part.

How the kidney is to be studied.

Arrangement.—The *uriniferous tubes* (tubuli uriniferi) are the ramified terminations of the excretory duct, which pour out the urine. In the cortex of the kidney, where the tubes present closed extremities (tubes of Ferrein), they are innumerable, are very convoluted, and of different sizes, though they average about $\frac{1}{600}$th of an inch. In this part they are closely surrounded by a plexus of bloodvessels, and communicate freely with one another. A certain number of the tubes converge towards each pyramid, and having become straight, are directed downwards, as a conical bundle,

Uriniferous tubes; character in cortex of kidney; convoluted, surrounded by vessels; in pyramid straight,

to the apex of that body, where they open by somewhat dilated orifices. In the pyramid the tubes lie close together, and have but few vessels between them; they further diminish in number, from base to apex, by repeated unions, and are enveloped by a uniting or parenchymatous structure. On a section of one of the pyramids, near the lower end, the number of tubes was estimated by Krause at a hundred in a square line.

fewer in number and vessels; have open mouths inferiorly.

Structure and ending of the tubes.—The tubes consist of a thin special membrane; and they are lined by an epithelium of the spheroidal kind, which forms three-fourths of the thickness of the wall, except in the pyramid, where it is thinner, and the cells smaller and flatter. At the termination of the tubes in free extremities each tube presents a dilated or saccular part, which contains a small vascular Malpighian body, and is perforated by the two vessels connected with that body.* Into this little sac the epithelial lining extends, and becomes very delicate and translucent. Dilatations for the lodgment of the Malpighian bodies are connected with the sides, as well as the ends of the tubes.

Structure of the wall of a tubule; special membrane and epithelium.

The *Malpighian corpuscles* (glomeruli of Ruysch) are small, rounded or oblong vascular bodies, which are contained in the dilated sacs of the uriniferal tubes. Each little vascular tuft has commonly a diameter of $\frac{1}{120}$th of an inch, and is formed by the capillary ramifications of two small vessels that perforate the end of the containing tube. One vessel (afferent) is a small twig of the renal artery, which forms the exterior of the tuft by its branchings; the other (efferent) occupies the centre of the tuft, and issuing from the tube ends in the plexus on a neighbouring uriniferal tube. This capillary body is free in the cavity of the tube that secretes the urine, but it is covered by some nucleated scales.

Corpuscles in the tubules. Size; composed of two vessels.

Bloodvessels.—The artery and vein that are distributed to the kidney are very large in proportion to the size of the organ they nourish; and some small arterial branches have a peculiar disposition in the Malpighian bodies before they become capillary, and end in the veins.

Bloodvessels are large, and arteries are peculiar.

* See a Paper in the *Philosophical Transactions* for 1842, Part I., On the Structure and Use of the Malpighian Bodies of the Kidney, by W. Bowman, F.R.S.

Renal artery.— As the artery enters the kidney it divides into four or five branches, which are invested by sheaths of the fibrous capsule, and are transmitted to the cortical substance between the pyramidal masses. Some of the offsets of a chief branch enter the pyramidal mass, and ramify on the tubes, forming anastomotic loops parallel with those tubes, whilst the continuation of the trunk is distributed in the cortex around the pyramid. The terminal twigs of the artery end either in the Malpighian bodies or in a vascular plexus around the uriniferal tubes. Branches of the artery reach exterior, supply tubules, and form glomeruli.

Renal vein. — This vein begins in the capillary plexuses on the convoluted urine tubes, and its larger branches are directed to the centre of the kidney, where they communicate around the pyramidal masses. From this spot the divisions of the vein accompany those of the artery, and are united finally into one trunk that opens into the vena cava. Some of the small roots of the vein may be seen to form an arborescent appearance on the surface of the kidney. Veins begin around tubules, and end in vena cava.

The URETER is the tube by which the fluid secreted in the kidney is conveyed to the bladder. Its relative anatomy must be studied afterwards, when the body is in a suitable position. Between its origin and termination the duct measures from sixteen to eighteen inches in length. Its size corresponds commonly with that of a large quill; but near the kidney it is dilated into a funnel-shaped part, named *pelvis*, and near the bladder it is again somewhat dilated, though the lower aperture, by which it terminates, is the narrowest part of the tube. Ureter; office; length. Size varies.

In its course from one viscus to another, the ureter is close beneath the peritoneum, and is directed obliquely downwards and inwards along the posterior wall of the abdomen as far as the pelvis, where it becomes almost horizontal in direction in the posterior false ligament of the bladder. At first the ureter is placed over the psoas muscle, inclining on the right side towards the inferior vena cava; and then it lies over the common or the external iliac artery *, being situate between the vessel and the sigmoid flexure on the left side, and between that artery and the end of the ileum on the right side. Lastly, it will be subsequently seen to lie in the posterior ligament of the bladder, below the level of the Course and connections.

* In a dozen uninjected bodies that were examined for me by Mr. S. F. Statham, the ureter was found as frequently over the one as the other of the two vessels mentioned.

obliterated hypogastric artery. About the middle of the psoas this excretory tube is crossed by the spermatic vessels. Sometimes the ureter is found divided into two for a certain distance.

Sometimes double.

Ureter dilated near the kidney, has calices, which embrace pyramids.

Part in the kidney.—Near the kidney the ureter is dilated into a pouch, named *pelvis*, in the hilum; and when traced upwards into the viscus, it is found to begin by a set of cup-shaped tubes, named *calices*, or infundibula, which vary in number from seven to thirteen. Each cup-shaped part embraces the rounded end of a pyramidal mass, and receives the urine that flows through the apertures in that projection; and sometimes a calyx surrounds two or more papillæ. The several calices are united together to form two or three larger tubes; and these are finally blended in the excretory duct or the ureter.

Two coats in ureter, muscular and mucous.

Structure.—The ureter consists of an external or muscular, and an internal or mucous coat. The *muscular* covering is composed of an external or longitudinal, and an internal or circular stratum. The *mucous* coat is thrown into longitudinal folds during the contracted state of the ureter, and is lined by an epithelium of the spheroidal form.

The calices also two coats.

The *calices* resemble the rest of the duct in having a muscular and a mucous coat. Around the pyramid the enveloping tunic of the kidney is continuous with the calyx; and at the apex of that body, the mucous lining is prolonged into the uriniferal tubes through the small openings in the papilla.

THE SUPRARENAL CAPSULE.

Use unknown.

This small body, whose use is unknown, has received its name from its position in the abdomen. Its vessels and nerves are numerous, but it is not provided with any excretory duct.

No duct.

Situation,

It is situate, one on each side, on the front of the upper extremity of the kidney; and without care it may be removed with the surrounding fat, which it resembles. Its colour is yellowish; and its form resembles that of a cocked hat. The upper part is convex, but the base or lower part is hollowed, where it touches the kidney. Its size in the adult is about one inch and a half in depth, and rather less

form and colour, size and weight.

in width; and its weight is between one and two drachms, but the left is commonly larger than the right capsule.

Some areolar tissue attaches the suprarenal body to the kidney, and large vessels and nerves retain it in situation. The connections with the surrounding parts are the same as those of the upper end of the kidney. Thus this body rests on the diaphragm on both sides; whilst above the right one is the liver, and above the left the pancreas and the spleen. On the inner side of the right capsule is the vena cava, with part of the solar plexus; and internal to the left is the aorta, with the same plexus of nerves. Connections.

Structure.—By means of a perpendicular section, the suprarenal body will be seen to be formed of a firm external or cortical part, and of an internal soft and dark material. The whole is surrounded by a thin *fibrous capsule*, that sends processes into the interior and along the bloodvessels. With the aid of a microscope, the nature of the two materials above noticed will be found to be as below stated:— A capsule surrounds it. Two different structures, viz.—

The *cortical* part is yellowish in colour and striated. Its stroma is formed of fine connective tissue which builds up spaces elongated from without inwards for the lodgment of the special structure. Its ultimate elements consist, according to Mr. Simon, of very small closed bodies or tubes, about $\frac{1}{700}$th of an inch in diameter, which are arranged vertically around the central part, and surrounded by bloodvessels. In these fine microscopic tubes there are contained bodies like nuclei, together with nucleated granular cells, granules, and particles of oil. a cortical, which consists of tubules,

The *central* soft part is of a grayish colour, or rather red, or of a black or dark brown hue from bloodvessels; it is formed chiefly of a plexus of minute veins with some elements similar to those in the cortical part. In the interior of the mass there is a space, apparently from breaking down of the interior parts. and a central vascular part.

Bloodvessels.—Numerous branches of *arteries* are furnished to the suprarenal body from the diaphragmatic and renal arteries, and from the aorta. In the interior of this body the arteries end in capillary plexuses that surround the small tubes above described. Arteries.
The *veins* originate in the plexuses on the tubes, and the several branches are collected into a trunk which opens on the right side into the vena cava, and on the left, into the renal vein. Veins.

THE TESTES.

Testes situated in the scrotum and enveloped by a serous sac.

The testes are two glandular organs for the secretion of the semen, and are lodged in the scrotum. Each is suspended by the spermatic cord and its coverings (p. 483), but the left is usually lower than the right; and each is provided with an excretory duct named vas deferens. A serous sac surrounds partly each organ.

To see the serous sac.

Dissection. — For the purpose of examining the serous covering of the testicle (tunica vaginalis), make an aperture into it and inflate it. The surface of both the sac and the spermatic cord are then to be cleaned, and the vessels of the latter are to be followed to their entrance into the testicle.

Serous bag

The *tunica vaginalis* is a serous bag, which is continuous with the peritoneal lining of the abdomen in the fœtus, but becomes subsequently a distinct sac, in consequence of the obliteration of the tube that connected the two. It invests the testicle after the manner of other serous membranes; for the testicle is placed behind it, so as to be partly enveloped by it, and yet not in the enclosed cavity. The sac, however, is larger than is necessary for covering the testicle, and projects some distance above it. Like other serous membranes, it has an external rough, and an internal secerning smooth surface; and like them it has a visceral and a parietal part. To examine its disposition the sac should be opened.

partly covers the testicle, and lines scrotum.

Its visceral part,

The visceral layer (tunica vagin. testis) covers the testicle, except posteriorly where the vessels enter or leave it, and is inseparably united with the special fibrous coat of the viscus. On the outer side it extends farther back than on the inner, and passes between the testis and the arched body (epididymis) that lies on this aspect of the organ.

and parietal.

The parietal part of the sac (tunic. vagin. scroti) is more extensive than the piece covering the testicle, and lines the immediately contiguous layer of the scrotum.

Testicle oval.

Form and position of the testis. — The testicle is oval in shape, with a smooth surface, and is flattened on the sides.

Margins.

The anterior margin is convex; and the posterior, which is flatter, is pierced by the spermatic vessels and nerves.

Bodies on the testicle.

Stretching like an arch along the outer part of the testis is the epididymis, or the convoluted part of the excretory duct

of the organ; and attached to the upper part of the testis, or that of the epididymis, is a very small body, two or three lines in length, whose use is unknown.

Suspended obliquely.

It is suspended obliquely, so that the upper part is directed forwards and somewhat outwards, and the lower end backwards and rather inwards.

Dimensions and weight.

Size and weight. — In length the testis is an inch and a half or two inches; from before backwards it measures rather more than an inch; and from side to side rather less than an inch. Its weight is nearly an ounce, and the left is frequently larger than the other.

A dense tunic contains small secreting tubes.

STRUCTURE.—The substance of the testicle is composed of a mass of minute secerning tubes, around which the bloodvessels are disposed in plexuses. Surrounding and supporting the delicate seminiferal tubes is a dense covering of the tunica albuginea. Its excretory or efferent duct is named vas deferens.

How to see the structure of the testis.

Dissection. — With the view of examining the investing fibrous coat, let the testis be placed on its outer side, viz. that on which the epididymis lies, and be fixed in that position with pins. The fibrous coat may then be cut through along the anterior part, and raised as far backwards as to the entrance of the bloodvessels: in this proceeding a number of fine bands will be seen traversing the substance of the testicle, and a short septal piece (mediastinum) will be observed at the back of the viscus, where the vessels enter. It will be necessary to remove part of the testicular mass of tubes, to bring into view the mediastinum, and to trace back some of the finer septa to it.

Fibrous coat; characters; use.

The *tunica albuginea*, or the fibrous coat of the testicle, is of a bluish-white colour, and resembles in appearance and structure the sclerotic coat of the eye-ball. This membrane supports the soft glandular part of the testicle, and maintains the shape of the organ by reason of its dense and unyielding nature. Besides determining the general form, it sends inwards processes to support and separate the seminal tubes. These several offsets of the membrane are seen in the dissection that has been made; and one of them, which is larger than the rest, is placed at the back of the testicle, and is named mediastinum.

Sends inwards processes, which are me-

The *mediastinum testis* (corpus Highmorianum) projects

diastinum and — into the gland for the distance of a few lines with the bloodvessels. It is situate at the back of the testis, extending from the upper nearly to the lower part, and is larger and deeper above than below. When cut across it will be seen to be formed of two lateral pieces, which are united anteriorly at an acute angle: to its front and sides the finer septal processes are connected; and in its interior are contained the bloodvessels, and a network of seminal ducts forming the rete testis.

finer septa. — Of the *finer processes* of the tunica albuginea, which enter the testis, there are two kinds: those of one set are round, cord-like, but of different lengths, are fixed posteriorly to the mediastinum, and serve to maintain the shape of the testis; those of the other, form delicate membranous septa, which divide the seminal tubes into masses named lobes, and are continued, like the rest, to join the mediastinum.

A vascular layer lines it (tunica vasculosa). — *Tunica vasculosa.*—Within the tunica albuginea is a thin vascular layer, which has been named as above by Sir A. Cooper. It lines the fibrous coat, covering the different septa in the interior of the gland; and is formed of the ramifications of the bloodvessels united by areolar tissue, like the pia mater of the brain. In it the arteries are subdivided before they are distributed on the secerning tubes, and the veins in the interior are supported by it.

Seminal tubes; — *Form and length of the seminal tubes* (tubuli seminiferi). —These secerning tubes are the minute branched extremities

appearance and — of the duct or vas deferens. They are very wavy, and are but slightly held together by fine connective tissue and surrounding bloodvessels, so that they may be readily drawn

length; — out of the testis for some distance. Their length is said by Monro to be sixteen feet, but by Lauth to be only two feet and a quarter. The size and the characters of the minute tubules can be learned only with the aid of the microscope.

Ending, size and structure. — Towards the circumference of the testis, the tubes have for the most part distinct closed

communications; — extremities; but some communicate, forming loops or arches, and others are united deeper in the gland. The diameter of

size; — the tubules varies from $\frac{1}{200}$th to $\frac{1}{150}$th of an inch. The wall

structure. — of the tubuli, formed of connective tissue, is thin, but it has considerable strength: lining the interior is a nucleated

granular epithelium, with polygonal cells, and on the exterior is a plexus of bloodvessels.

Names from the arrangement of the tubes. — The names of the several parts of the testis are derived from the disposition of the seminal tubes in the interior. Thus, where the tubules are collected into separate masses, they form the lobes of the testis ; as they enter the fibrous mediastinum they become straight and are named tubuli recti ; where they communicate in the mediastinum, they produce the rete testis ; and, lastly, as they leave the upper part of the gland, and become convoluted, they are called coni vasculosi, or vasa efferentia. Tubes change their name.

The *lobes of the testis* are formed, as above explained, by bundles of the seminiferal tubes, and are situate in the intervals between the processes sent inwards from the tunica albuginea. The number of these is differently stated: according to one authority (Berres) they are 250: but according to another (Krause), 400 or more. They are conical in form, with the base of each turned to the circumference, and the apex to the mediastinum testis. Each is made up of one, two, or more tortuous seminal tubules; and the tubes in one lobe are sometimes united with those in the neighbouring lobes. Towards the apex of each lobe the tubules become less bent, and are united together ; and the tubuli of the several lobes are further joined at the same spot into larger canals that form the tubuli recti. They form the lobes. Number of lobes ; form. Tubes in them and arrangement.

Tubuli recti.— The seminal tubes that issue from the several lobes unite together, becoming larger in size and straighter in direction, and are named tubuli recti or vasa recta : they are about twenty in number, and pierce the fibrous mediastinum, entering into its interior. Tubes next become straight (tubuli recti) ;

Rete testis. — In the substance of the mediastinum the tubes lose their former name, and are directed to the upper end of the testis. They are situate in the anterior part of that fibrous process, in front of the bloodvessels, and freely communicate, so as to form a network, the rete testis. afterwards join together (rete testis),

Vasa efferentia. — About twelve or twenty seminal tubes issue from the top of the rete testis, and leave the upper part of the testicle as the vasa efferentia. These are larger than the tubes of which they are the continuation, and end in the common excretory duct. Though straight at first and then leave the gland (vasa efferentia).

they soon become convoluted; whence the name *coni vasculosi*, that has been given to them. When they are unravelled, they are from six to eight inches long; and they will be found to join the excretory duct at intervals of about three inches.

Excretory duct

The EXCRETORY DUCT of the testis receives the vasa efferentia from the upper part of the gland, and extends thence to the urethra. Its first part, which is in contact with the testis, is very flexuous, and forms the epididymis; but the remainder is straight, and is named vas deferens.

is bent on the testicle forming epididymis;

The *epididymis* extends in the form of an arch, along the outer side of the testis, from the upper to the lower end, and receives its name from its situation. Opposite the upper part of the testicle it presents an enlarged portion or head, the *globus major*, and at the lower part of that organ it becomes more pointed or tail-like — *globus minor*, before

how named;

ending in the vas deferens. The intervening narrow part of the epididymis is called the body. Its head is attached to the testis by the vasa efferentia that open into it; and its tail or lower part is fixed to the tunica albuginea by some fibrous tissue, and by the reflection of the tunica vaginalis.

is but a single tube;

After the removal of the serous membrane and some fibrous tissue, the epididymis may be seen to be formed of a single tube, bent into a zigzag form, whose bends are united into

length and size.

one mass by fibrous tissue. This part of the tube, when unravelled, measures twenty feet in length. The diameter of its canal is about $\frac{1}{70}$th of an inch; but there is a slight diminution in size towards the globus minor.

Where it is straight it is the vas deferens;

The *vas deferens* begins opposite the lower end of the testis, at the termination of the globus minor of the epididymis. At first this part of the excretory duct is slightly wavy, but afterwards it becomes for the most part a firm round tube. In its course to the urethra, it ascends on the inner side of the testicle to reach the bloodvessels of the

this opens into the urethra;

spermatic cord, with which it enters the internal abdominal ring; it is then directed along the side of the bladder, and through the prostate, to open on the inner surface of the

length and size.

latter (see PELVIC VISCERA, p. 599.). The length of this part of the excretory duct is about two feet, and the width of its canal about $\frac{1}{30}$th of an inch. Near its termination the vas

deferens becomes enlarged and tortuous; but this condition will be referred to with the viscera of the pelvis.

Connected with the vas deferens, in the angle of union between it and the epididymis, is found sometimes a small narrow cæcal appendage, the *vas aberrans* of Haller. This body is convoluted, and projects upwards for two or three inches amongst the vessels of the cord. Like the epididymis, it is much longer when it is unravelled, measuring sometimes fourteen inches, but it may not exceed an inch and a half in length. Its capacity is greatest at the free end. Its use is unknown. The vas aberrans may be found divided or doubled. Vas aberrans occasionally present; situation and size.

Structure. — The excretory duct of the testis is formed chiefly by a thick, muscular coat; this is covered externally by areolar tissue, and lined internally by mucous membrane. To the feel the duct is firm and wiry, like whip-cord; and on a section its wall is dense and of a rather yellow colour, but it is thinnest at the head of the epididymis. The *muscular coat* is composed of longitudinal and circular fibres arranged in strata, so that both externally and internally is a longitudinal layer, the latter being very thin; and between them is a layer of circular fibres. The *mucous membrane* is marked by longitudinal ridges in the straight part of the canal, and by irregular ones in the sacculated portion. A columnar epithelium covers the inner surface. Two coats form the duct; a muscular and a mucous.

The canal of the vas deferens is larger than that of the epididymis, as before stated. The vas aberrans resembles the vas deferens in structure. Vas aberrans like the duct.

Bloodvessels and nerves of the testicle. — The branches of the *spermatic artery* pierce the back of the testis, and enter the posterior part of the mediastinum, behind the rete testis. Leaving the mediastinum, the vessels are finely divided in the vascular membrane that lines the interior of the tunica albuginea. After being thus divided, offsets are continued on the fine septa between the lobes to the seminal tubules, on which they are distributed. The *spermatic veins* begin in the plexuses around the seminal tubes, and issue from the gland at the posterior part: they then ascend along the cord, forming a plexus, and end in one trunk; that on the right side joins the vena cava, and that on the left, the renal vein (p. 577.). The *lymphatics* ascend on the bloodvessels, and join the lumbar glands. The *nerves* are derived from the sympathetic, and accompany the arteries to the testis. Artery. Veins. Lymphatics and nerves.

Vessels of the duct.

Vessels of the vas deferens.— A special bloodvessel, the *artery of the vas deferens*, is furnished to the excretory duct from the upper vesical artery; and some *veins* from the *epididymis* enter the spermatic veins.

Section V.

AORTA AND VENA CAVA, AND THE DEEP MUSCLES.

Dissect blood-vessels and muscles.

Directions.—After the body is replaced in its former position on the back, the student should prepare first for examination the diaphragm, next the large vessels and their branches, and then the remaining deep muscles of the abdomen.

To see the diaphragm.

Dissection.—For the dissection of the diaphragm it will be necessary to remove the peritoneum from the under surface of that muscle, defining especially the central tendinous part, and the fleshy processes or pillars which are fixed to the lumbar vertebræ. Whilst cleaning the surface the student should be careful of the vessels and the nerves on or towards the pillars. On the right side two aponeurotic bands or arches, which give attachment to the muscular fibres, should be dissected out: — one curves over the psoas muscle; and the other extends from the transverse process of the first lumbar vertebra to the last rib.

Diaphragm. Situation and form.

The DIAPHRAGM forms the vaulted moveable partition between the thorax and the abdomen; it is fleshy externally, where it is attached to the surrounding ribs and the spinal column, and has its tendon in the centre. The *origin* of the muscle is at the circumference, and is similar on each side of the middle line. Thus, beginning in front and passing backwards, the diaphragm is connected by fleshy fibres with the posterior part of the xiphoid cartilage, and with the inner aspect of the six lower ribs; with two aponeurotic arches between the last rib and the vertebræ, —one being placed over the quadratus lumborum, and the other over the psoas muscle; and, lastly, it is connected with the lumbar vertebræ by a thick muscular part or pillar. From this extensive origin externally, the fibres are directed inwards, with different degrees of obliquity and length, to the central median tendon, but some have a peculiar disposition in the pillars which will be afterwards noted.

Origin at the circumference.

Insertion of fibres into a central tendon.

The abdominal surface is concave, and is covered for the most part by the peritoneum: in contact with it, on the right side, are the liver and the kidney; and on the left side, the stomach, the spleen, and the left kidney: in contact also with the pillars is the pancreas, together with the solar plexus and the semilunar ganglia. The thoracic surface is covered by the pleura and the pericardium, and is convex towards the thorax (p. 396.). At the circumference of the muscle, the fleshy processes of origin alternate with like parts of the transversalis muscle: a slight interval separates the slips to the xiphoid cartilage and the seventh rib; and a second interval sometimes exists between the fibres from the last rib, and those from the arch over the quadratus lumborum muscle. In the diaphragm are certain apertures for the transmission of parts from the thorax to the abdomen, viz. one for the œsophagus, another for the vena cava, and a third for the aorta between the pillars of the muscle and the spinal column: moreover, the pillars are perforated by the splanchnic nerves.

Parts in contact with the under surface,

and with the upper.

Attachment of border.

Apertures in the muscle.

The muscle is curved across the intercostal space, being convex towards the chest, and concave to the abdomen; and the arch reaches higher on the right than the left side (p. 342.). The height of the arch is constantly varying with the change in the condition of the diaphragm in respiration, being carried upwards or downwards from the average level. In forced expiration the muscle ascends and reaches the upper border of the fourth rib on the right, and the fifth rib on the left side. In forced inspiration it descends, and its slope would be represented by a line drawn from the ensiform cartilage towards the tenth rib.

Arch.

Height in forced expiration

and inspiration.

The following parts, that have been mentioned incidentally in describing the diaphragm, are now to be noticed more fully; they are the central tendon, the pillars, the arches, and the apertures.

Special parts to be examined.

The *central tendon* (tendo diaphragmatis, cordiform tendon), occupying the middle of the diaphragm, is surrounded by muscular fibres, and the large vena cava pierces it. It is of a pearly white colour, and its tendinous fibres cross in different planes and in different directions. In form it resembles a trefoil leaf; of its three segments the right one is the largest, whilst the left is the smallest.

Central tendon,

like a trefoil leaf.

Two pillars, with certain resemblances. The *pillars* (crura, appendices) are two large muscular and tendinous processes, one on each side of the abdominal aorta. They are pointed and tendinous below, where they are attached to the upper lumbar vertebræ, but large and fleshy above; and between them is a tendinous arch over the aorta. Arrangement of fibres in each, In each pillar the fleshy fibres succeed to a pointed tendon, and pass upwards and forwards, diverging from each other. The greater number join the central tendon without intermixing. as they ascend to the tendon. But the internal fibres of opposite sides cross one another in the following manner: those of the right side, for instance, ascend by the side of the aorta, and pass to the left of the middle line, decussating between that vessel and the opening of the œsophagus with their fellows; having changed sides, these fibres are directed upwards to the central tendon around the œsophagean opening, which they limit on the left. The fibres of the other crus may be traced in the same way, to form the right half of the œsophagean opening. In the decussation between the aorta and the œsophagus the fasciculus of fibres from the right crus is generally larger than that from the left, and commonly anterior to it.

Differences in the pillars. The pillars differ somewhat on opposite sides. The right is the larger of the two, and is fixed by tendinous processes to the front of the bodies of the first three lumbar vertebræ, as well as their intervertebral substance, reaching to the intervertebral disc between the third and fourth vertebræ. The left pillar *, which is situate more on the side of the spine, is partly concealed by the aorta, and does not reach so far as the right by the depth of a vertebra, or of an intervertebral substance.

Two arches, The *arches* (ligamenta arcuata) are two fibrous bands over the quadratus lumborum and psoas muscles on each side. internal or true, The arch over the psoas (lig. arcuat. internum) is the strongest, and is connected by the one end to the tendinous part of the pillar of the diaphragm, and by the other end to the transverse process of the first or the second lumbar vertebra. and external or false. The external arch over the quadratus lumborum muscle (lig. arcuat. externum) is only a thickened part of the fascia covering that muscle, and extends from the same

* Not very unfrequently this pillar may be found wanting.

transverse process (first or second lumbar) to the last rib. As before said, fleshy fibres take origin from both bands.

Apertures. — There are three large openings in the diaphragm for the aorta, the vena cava, and the œsophagus; with some smaller fissures for nerves and vessels. The opening for the aorta is rather behind than in the diaphragm, for it is situate between the pillars of the muscle and the spinal column: it transmits the aorta, the thoracic duct, and sometimes the vena azygos. The opening for the œsophagus and the pneumo-gastric nerves is rather above and to the left of the aortic aperture: it is situate in the muscular part of the diaphragm, and is bounded by the fibres of the pillars, as above explained. The opening for the vena cava is placed in the right division of the central tendon, or between the right and middle pieces, and its margins are attached to the vein by tendinous fibres. It is described as being of a square form (foramen quadratum).

Apertures are— For the aorta; its contents. For œsophagus and nerves. For the vena cava.

There is a *fissure* in each pillar for the splanchnic nerves, with one, in the left, for the small azygos vein. Sometimes the large azygos vein pierces the right pillar instead of passing with the aorta.

Fissures in the pillars.

Dissection. — After the diaphragm has been learnt, the ribs that support it on each side may be cut through, and the pieces of the ribs together with the diaphragm, except the pillars and the arches with the diaphragmatic vessels at the posterior part, may be taken away to make easier the dissection of the deeper vessels and muscles.

Take away greater part of the diaphragm.

The large vessels of the abdomen, viz. the aorta and the vena cava, are to be now cleaned by removing from their surface the fat with the remains of the sympathetic and the lymphatic glands; and their branches are also to be followed to the diaphragm, to the kidney and the suprarenal body, to the testicle, and to the lumbar vertebræ and the spinal cord. In like manner the large iliac divisions of the aorta and cava are to be laid bare as far as Poupart's ligament. The ureter and the spermatic vessels are to be cleaned as they cross the iliac artery; and on this artery branches of a small nerve (genito-crural) are to be sought near the thigh.

Aorta, cava, and branches.

The psoas, quadratus, and iliacus muscles are to be cleaned on the right side; but on the left side the fascia covering the muscles is to be shown, and the fat to be cleared away

Dissect psoas.

Nerves of lumbar plexus.

from about the kidney. The psoas muscle is the more internal, and lies on the side of the spine: on its surface, and in the fat external to it, the branches of the lumbar plexus will be found. The genito-crural nerve lies on the front; and four other nerves issue at the outer border — the ilio-hypogastric and ilio-inguinal near the top, the external cutaneous about the centre, and the large anterior crural at the lower part. Along the inner border of the muscle the gangliated cord of the sympathetic is to be sought with a chain of lumbar lymphatic glands; and somewhat below the pelvic part of the muscle, the obturator nerve. External to the psoas is the quadratus lumborum muscle, and crossing it near the last rib is the last dorsal nerve, with an artery. In the hollow of the hip bone is the iliacus muscle. Both muscles may be cleaned on the right side, whilst the fascia that covers them may be observed on the opposite side.

Dissect quadratus lumborum.

Iliacus muscle.

Extent of the aorta.

The ABDOMINAL AORTA extends from the last dorsal vertebra to the left side of the body of the fourth lumbar vertebra, where it divides into the common iliac arteries. Its commencement is between the fleshy pillars of the diaphragm, and its termination is nearly on a level with the highest part of the crest of the hip bone. The connections of the vessel with surrounding parts have been before referred to (p. 519.), and its branches now remain to be examined.

Connections.

Place of origin of the branches;

The *branches* of the aorta are numerous, and arise in the following order: — First, are the diaphragmatic arteries, two in number, which, if they arise separately, leave the sides of the vessel immediately it appears in the abdomen. Close to the tendinous ring of the diaphragm the single trunk of the cœliac axis arises from the front of the aorta; and about a quarter of an inch lower down, also on its front, the trunk of the superior mesenteric artery begins. Half an inch lower the renal arteries, right and left, take origin from the sides of the aorta. On the fore part of the trunk, close above each renal, is the small capsular branch, and below the renal is the spermatic artery. From the front of the aorta, one to two inches above the bifurcation, springs the inferior mesenteric artery; and from the angle of division the small middle sacral artery runs downwards. Four or five small lumbar arteries on each side come from the pos-

terior part of the vessel, opposite the bodies of the corresponding vertebræ.

The branches may be classified into two sets, — one that supplies the viscera of the abdomen (visceral), and another that is furnished to the abdominal walls (parietal). their classification.

A. The *visceral branches* are cœliac axis, superior and inferior mesenteric, renal, capsular, and spermatic. All this set, except the last three, viz. the renal, capsular, and spermatic, have been examined (p. 513—522.). Visceral branches.

The *renal arteries* leave the aorta nearly at a right angle, and are directed outwards, one on each side. Near the kidney each divides into four or five branches, which enter the renal substance between the vein and the ureter. Each lies beneath its companion vein, being surrounded by a plexus of nerves, and supplies small twigs to the suprarenal capsule (inferior capsular), to the ureter, and to the fatty layer about the kidney. Renal artery. is beneath its vein; gives offsets.

The arteries of opposite sides have some differences. The left is the shortest, owing to the position of the aorta. The right crosses the spine, and passes beneath the vena cava. Varieties, both in the number, and the place of origin of this artery, are frequent. Difference between left and right.

The *middle capsular artery* is a small branch that runs almost transversely outwards to the suprarenal body, to which it is distributed. This artery anastomoses with the other branches supplied to the suprarenal body by the renal and phrenic arteries. It is of large size in the fœtus. Capsular artery.

The *spermatic artery* is destined for the testicle, and is remarkable for being small in size in proportion to its length; for leaving the cavity of the abdomen; and for having the part in the abdomen straight, but that in the cord tortuous. From its origin below the renal, the vessel passes downwards along the posterior wall of the abdomen, beneath the peritoneum, to the internal abdominal ring, where it enters the spermatic cord, as before described (p. 484.). In the course specified the vessel passes first along the front of the psoas, crossing over the ureter; and as it leaves the abdomen it turns round the epigastric artery, but is separated from that vessel by the vas deferens. On the right side the artery crosses the vena cava. It is accompanied by the spermatic vein, and the spermatic plexus of nerves. Spermatic artery is remarkable. Course to the testicle.

In the female. In the female the corresponding artery (ovarian) descends into the pelvis to the ovary and the uterus.

Condition in fœtus. In the fœtus, before the testicle leaves the abdomen, the spermatic artery is very short, but the vessel becomes elongated in proportion as the part supplied is removed from its former site.

Branches to wall of abdomen. B. The *parietal branches* of the aorta are the phrenic, lumbar, and middle sacral arteries.

Inferior phrenic; The *diaphragmatic* or *inferior phrenic arteries* are directed upwards and outwards along the under surface of the diaphragm, near the posterior part, and end in anastomotic and course of left and right. muscular branches. The left artery passes behind the œsophageal opening, and the right behind the vena cava. Each Distribution. ends in two branches: — one (internal) passes onwards towards the fore part of the diaphragm, and anastomoses with its fellow of the opposite side, and with the branches (musculo and superior phrenic) that are supplied to the diaphragm from the internal mammary (p. 267.); the other (external) is larger, and is directed outwards to the side of the muscle, where it meets with the intercostal arteries.

Small offsets. Small *branches* supplied to the suprarenal body by the external division of this artery are named superior capsular. Some twigs are given by the left artery to the œsophagus, and by the right to the vena cava.

The other parietal branches, viz. lumbar and middle sacral, are not dissected in this stage: the former will be seen after the lumbar plexus (p. 586.), and the latter in the pelvis.

Common iliac: extent and termination. The COMMON ILIAC ARTERY is directed outwards from the bifurcation of the aorta to the base of the sacrum, and divides into two large trunks opposite the fibro-cartilage between that bone and the last lumbar vertebra: — one of these supplies the lower limb (external iliac), and the other enters Connections. the pelvis (internal iliac). Placed obliquely on the vertebral column, the vessel measures about two inches in length, and is covered by the peritoneum, by branches of the sympathetic nerve, and sometimes by the ureter. It is accompanied by Branches. a vein of the same name. Usually it does not furnish any named branch, but it may give origin to the ilio-lumbar, or a renal artery.

Difference between right On opposite sides the vessels have some differences. The artery of the right side is rather the longest, in consequence

of the position of the aorta on the left side of the spine. To its outer side at first is the vena cava, and near its termination is the psoas muscle. The companion vein is at first beneath, but external to the artery at the upper part, where it enters the vena cava in that position; and beneath the right artery also is the left common iliac vein. The left artery is crossed by the continuation of the inferior mesenteric artery, and the corresponding vein is situate below it. and left vessel.

Peculiarities. — The *place of origin* changes with that of the bifurcation of the aorta. Place of origin;

The *length* ranges from less than half an inch (in one case) to four inches and a half; but in the majority of instances, it varies between one inch and a half and three inches (Quain). length;

The *place of division* oscillates between the middle of the last lumbar vertebra, and the upper border of the sacrum, but occasionally it will be above or below those points. Generally the left artery divides lower than the right. place of division.

The EXTERNAL ILIAC ARTERY is the commencement of the leading vessel of the lower limb, and is contained in the cavity of the abdomen. External iliac leads to lower limb. Its extent is from the bifurcation of the common iliac to the lower border of Poupart's ligament, where it becomes femoral; and its direction would be indicated, on the surface of the abdomen, by a line from the left of the umbilicus to the middle of the space between the symphysis pubis and the front of the iliac crest. Extent and direction. The vessel lies above the brim of the pelvis, in its course to Poupart's ligament, and is covered closely by the peritoneum and the subperitoneal layer in all its extent. Connections with parts around, Near its origin it is crossed sometimes by the ureter; and near Poupart's ligament the spermatic vessels, and part of the genito-crural nerve, lie on it for a short distance, whilst the circumflex iliac vein crosses it, and the vas deferens bends down along its inner side. To the outer side of the vessel is the psoas, except at its termination under Poupart's ligament, where that muscle lies beneath it. A chain of lymphatic glands is placed along the front and the inner side of the artery. The position of the external iliac vein is not the same on both sides. and with vein. On the left side the vein is altogether internal to the artery; whilst on the right side the vein, though internal in position on the pubes, afterwards lies beneath the arterial trunk.

Two branches: Two large *branches*, epigastric and circumflex iliac, arise from the artery a few lines from its end, and are distributed to the wall of the abdomen (p. 486.): but the number of the branches may be altered by the epigastric being transferred from it, or by the other being divided into two. Some small unnamed twigs are given by it to the psoas muscle and the lymphatic glands.

origin varies. *Peculiarities. — In position of usual branches.* — The epigastric and circumflex branches may wander over the part of the artery between Poupart's ligament and one inch and a half, or two inches and a half above that band; of the two the epigastric arises highest.

Occasional branches from it. *In unusual branches.* — Though the trunk of the vessel is commonly free from any unusual branch, it may be occupied between the end and the middle by the obturator artery, or by the internal circumflex artery of the thigh.

Veins of the abdomen, except vena portæ. Veins.— The veins of the abdomen correspond so closely with the arteries, both in the number, extent, and connections of the trunks, as to render unnecessary the same detail as in the description of the arteries. Further, as the veins increase in size from the circumference towards the centre of the body, those most distant from the heart will be first described.

Anatomy of external iliac. The *external iliac* continues the femoral vein to the abdomen beneath Poupart's ligament. It has an extent like that of the artery of the same name, and ends by uniting with the vein from the pelvis (internal iliac) to form the common iliac vein. Position to artery. On the pubes it is on the same level as the artery, and lies inside it between the psoas and pectineus muscles; but this position is not retained throughout, for, though the left vein remains internal to, the right slips beneath its artery.

Branches. The veins that open into it are the epigastric and circumflex iliac (p. 487. and 488.).

Common iliac veins form cava. The *common iliac vein* ascends by the side of its companion artery, the right almost vertically, and the left obliquely, to the right side of the body of the fifth lumbar vertebra (the upper part), where the two are blended in one trunk — the vena cava. Difference in length and connections. The right vein is the shortest, and is at first behind, but afterwards outside the artery of the same side. The left is altogether below the artery of its own side, and moreover crosses beneath the right common iliac artery.

Veins to it.

Each receives the ilio-lumbar, and sometimes the lateral sacral branch; and the common iliac of the left side is joined by the middle sacral vein.

Place where the veins join may change.

Peculiarities.—Instead of the common iliac veins uniting at the spot mentioned, they may be continued upwards, one on each side of the aorta, as high as the kidney, before the left crosses the spine to join the right, and give origin to the vena cava. In these cases the vein on the left side receives one renal vein, and the two common iliacs are connected by a small intervening branch at the spot where they are usually united.

Lower cava is by side of the aorta.

The VENA CAVA INFERIOR collects, and conveys to the heart the blood of the lower half of the body. Taking origin, as before said, on the right side of the fifth lumbar vertebra, rather below the bifurcation of the aorta, this large vein ascends on the right side of the vertebral column, and reaches the heart by perforating the diaphragm. Its connections with the surrounding parts have been already described (p. 519.).

Extent and connections.

Branches from abdomen, except those of digestive apparatus.

In this course the cava receives parietal branches from the wall of the abdomen and the diaphragm, and visceral branches from the testicle, the kidney, the suprarenal body, and the liver. The veins belonging to the digestive apparatus, viz. to the intestinal canal, the spleen, and the pancreas, are united to form the vena portæ (p. 525.); and the blood circulating in those veins reaches the cava only after it has circulated through the liver, and then through the indirect channel of the veins of the liver, — the venæ cavæ hepaticæ.

Lumbar veins after.

The *lumbar veins* enter the posterior part of the vena cava, and correspond in number and course with the arteries of the same name: they will be dissected with those arteries.

Spermatic vein

The *spermatic vein* enters the abdomen by the internal abdominal ring, after forming the spermatic plexus in the cord (p. 484.). At first the vein consists of two branches in the abdomen, which lie on the sides of the spermatic artery; but these soon merge into one trunk, which ends on the left side in the renal vein, opening into it at right angles; and on the right side in the inferior cava, which it pierces obliquely below the renal vein. As the vein ascends to its destination, it receives one or more branches from the wall of the abdomen, and from the fat about the kidney.

ends differently on left and right sides.

Vein in the female. In the female this vein (ovarian) has the same ending as in the male, and it forms a plexus in the broad ligament of the uterus.

Renal vein; position to artery; difference on two sides. The *renal* or *emulgent vein* is of large size, and joins the vena cava at a right angle. It commences by many branches in the kidney; and the trunk resulting from their union is superficial to the renal artery. The right is the shortest, and joins the cava higher up than the other. The left vein crosses the aorta close to the origin of the superior mesenteric artery: it receives separate branches from the spermatic and suprarenal veins of the same side.

Branches.

Suprarenal ends differently on each side. The *suprarenal vein* is of considerable size when it is compared with that of the body from which it comes. On the right side it opens into the cava, and on the left side into the renal vein.

Phrenic veins. The *diaphragmatic veins* (inferior), two for each artery, spring from the under surface of the diaphragm. They join the cava either as one trunk or two.

Hepatic veins, before noticed. The *hepatic veins* enter the cava where it is in contact with the liver. These veins are described in the dissection of the liver (p. 553.).

Vena cava may be also on left side, or in part, *Peculiarities of the vena cava.* — *In position.* — When transposition of the viscera exists, the vena cava is found on the left of the spine. But without that transposition the vein may be on the left side of the aorta as high as the renal vein, before it crosses that vessel to take its usual place.

or may end in the azygos vein. *In ending.* — Instead of opening into the heart, the lower cava may be found entering the upper cava; and in these rare instances it finds its way to that vessel through the channel of the intercostal or azygos vein. In this condition the inferior cava is wanting at the heart, and the blood from the lower part of the body is then transmitted to the heart by the superior cava. Should this deviation exist, the hepatic veins would form a separate trunk, and open into the right auricle in the situation of the inferior cava.

THE DEEP MUSCLES.

The deep muscles in the interior of the abdomen, which remain to be learnt, are the psoas, iliacus, and quadratus lumborum. Some fasciæ are also to be seen in connection with the muscles.

Psoas magnus; The PSOAS MAGNUS reaches from the lumbar vertebræ to

the femur, and is situate partly in the abdomen and partly in the thigh. The muscle *arises* from the front of the transverse processes (parapophyses) of the lumbar vertebræ; from the bodies of the last dorsal and all the lumbar vertebræ by five processes, each process being connected with the intervertebral substance, and the upper and lower borders of the two contiguous vertebræ; and opposite the middle of the bodies of the vertebræ from tendinous bands over the bloodvessels. The fibres are directed downwards, and give rise to a roundish muscle, which gradually diminishes towards Poupart's ligament. Inferiorly the muscle ends in a tendon on the outer aspect, which receives the fibres of the iliacus, and passes beneath Poupart's ligament to be *inserted* into the small trochanter of the femur, and the contiguous part of the bone. situation; origin. Direction of the fibres. Insertion.

The abdominal part of the muscle has the following connections: — in front of it are the internal arch of the diaphragm, the kidney with its vessels and duct, the spermatic vessels and the genito-crural nerve, and, near Poupart's ligament, the ending of the external iliac artery. Posteriorly the muscle is in contact with the transverse processes, with part of the quadratus lumborum, and with the innominate bone. The outer border touches the quadratus and iliacus, and branches of the lumbar plexus issue from beneath it. The inner border is partly connected to the vertebræ, and is partly free along the margin of the pelvis: — along the vertebral part of this border lie the sympathetic nerve and some lumbar glands, with the cava on the right, and the aorta on the left side; along the pelvic part are the external iliac artery and vein, and the obturator nerve below. It has been before said that the muscle is connected only with the margins of the vertebræ; whilst opposite the centre of each bone, the fibres are attached to a tendinous arch over the lumbar vessels. Connections in front, behind; of outer border, of inner border; along pelvic and vertebral part.

The PSOAS PARVUS is a small muscle with a long and flat tendon, which is placed on the front of the large psoas, but is rarely present. Its fibres *arise* from the bodies of the last dorsal and first lumbar vertebræ, and their intervening fibro-cartilage, like the large psoas. Its tendon becomes broader inferiorly, and is *inserted* into the ilio-pectineal Psoas parvus; origin; insertion;

often absent. eminence and the brim of the pelvis. The tendon is connected with the fascia covering the iliacus muscle.

Iliacus has the form of the iliac fossa. The ILIACUS MUSCLE occupies the hollow (iliac fossa) on the inner aspect of the hip bone, and is blended inferiorly with the psoas muscle. It is triangular in form, and has a fleshy Origin; *origin* from the iliac fossa and the ilio-lumbar ligament, from the base of the sacrum, and in front from the capsule of the hip joint. The fibres pass inwards to the tendon of inser- tion; the psoas, uniting with it even to its *insertion* into the parts covering it on opposite sides. femur, and some reach separately that bone. Above Poupart's ligament the muscle is covered by the iliac fascia; but in front of the right iliacus is the cæcum, and in front of the left muscle is the sigmoid flexure. Beneath it are To the inner side is the psoas. the innominate bone and the capsule of the hip joint. The inner margin is in contact with the psoas and the anterior crural nerve. The connections of the united psoas and iliacus below Poupart's ligament are given with the dissection of the thigh.

Quadratus lumborum has two parts;— The QUADRATUS LUMBORUM is a short thick muscle between the crest of the hip bone and the last rib. About two inches wide inferiorly, it arises from the ilio-vertebral liga- outer, which is largest, and posterior; ment, and from the iliac crest for the same extent as that band, but behind it. The fibres ascend to be inserted into the body of the last dorsal vertebra, and the lower border of the last rib for a variable distance; and by distinct fleshy and tendinous slips into the apices of the transverse processes of the four upper or all the lumbar vertebræ. Occa- and inner, or anterior. sionally there is an anterior stratum of fibres at the upper part, which is attached internally to the tips of the transverse processes of the three middle lumbar vertebræ, and exter- It is contained in a sheath. nally to the lower border of the last rib. This muscle is incased in a sheath derived from the fascia lumborum. Crossing the surface are branches of the lumbar plexus, together with the last dorsal nerve. Beneath the quadratus is the mass of the erector spinæ muscle.

Fascia of the quadratus *Fascia of the quadratus.* — Covering the surface of the quadratus is a thin membrane, which is derived from the tendon of the transversalis abdominis (fascia lumborum, p. 409.), and passes in front of the quadratus to be fixed to the roots of the transverse processes; below to the ilio- forms lumbar ligament; and above to the last rib. This fascia

forms the thickened band called ligamentum arcuatum externum. lig. arc. extern.

Fascia of the iliacus and psoas. — This fascia covers the two muscles, and extends in different directions as far as their attachments. Over the iliacus muscle the membrane is thickest; and a strong accession is received from the tendon of the small psoas, when that muscle is present. Its disposition at Poupart's ligament, and the part that it takes in the formation of the crural sheath, have been before explained (p. 497.). When traced inwards over the psoas, the membrane will be found to be inserted into the hip bone near the brim of the pelvis; and when followed upwards it will be seen to become thin, to be fixed on the one side to the lumbar vertebræ and the ligamentum arcuatum internum, and to be blended on the other with the fascia on the quadratus: at its attachment to the vertebræ it has the same digitate and arched condition as the psoas. The fascia should be divided over the psoas on the left side, and reflected towards the brim of the pelvis. Iliac fascia joined by tendon of small psoas: attachments below; internally both to pelvis and the vertebræ.

Dissection. — The student is now to clean the lymphatic glands that lie along the vertebræ, and to trace upwards some lymphatic vessels to the thoracic duct. To show the commencement of the duct the diaphragm is to be divided over the aorta, and its pillars thrown to each side; then a piece may be cut out of the aorta opposite the first lumbar vertebra. The beginning of the duct (chyli receptaculum) and of the vena azygos may be well seen now, and may be followed upwards into the thorax. Trace the lymphatics. and the receptaculum, azygos vein,

On the left side the student may trace the splanchnic nerves and the small vena azygos through the pillar of the diaphragm, and show the trunk of the sympathetic nerve entering the abdomen beneath the arch over the psoas muscle. splanchnic nerves.

Lymphatic glands. — A chain of glands is placed along the side of the external iliac artery, and along the front and sides of the lumbar vertebræ; these are connected by short tubes, which increase in size and diminish in number until at the upper part of the lumbar vertebræ only three trunks remain to form the common thoracic duct. Into these glands the lymphatics of the lower limb, those of the viscera Lumbar lymphatics of the abdomen end in one duct. Lymphatics

entering glands. and wall of the abdomen, and those of the genital organs and testicle are received.

Beginning of the thoracic duct, *Receptaculum chyli.*— The thoracic duct begins in the abdomen, by the union of three or four large lymphatic vessels. Its commencement is marked by a considerable dilatation, which is named receptaculum chyli, and is placed on on right of aorta, at second lumbar vertebra. the right side of the aorta, about opposite the second lumbar vertebra. The duct then enters the thorax by passing through the diaphragm with the aorta.

Large azygos vein; *Beginning of the azygos veins.*— The right vein (vena azygos major) begins opposite the first or second lumbar vertebra by a small branch, which is continuous with a lumbar vein, or, it may be, with the vena cava or the renal entrance into thorax. vein. However formed, the vein enters the thorax with the thoracic duct and the aorta, to the right of which it lies; but it may pierce the crus of the diaphragm, as it leaves the Small azygos vein. abdomen. The left or small azygos vein begins on the left side of the spine, joining here one of the lumbar veins or the renal vein, and passes through the pillar of the diaphragm, or through the aortic opening. The anatomy of these veins is given in the description of the thorax, p. 388.

Section VI.

LUMBAR SPINAL NERVES AND THE CORD OF THE SYMPATHETIC.

The spinal nerves of the loins resemble those in the lower part of the neck, in being united in a plexus, and supplying a limb and the parts of the trunk contiguous to it.

Dissection of the lumbar plexus on left side, *Dissection.* — The lumbar nerves and their plexus are to be seen on the left side, and to bring them into view, the dissector should scrape away the left psoas. For the most part the fleshy fibres may be removed freely; but a small branch (accessory of the obturator) should be looked for at first at the inner border of the muscle. In the substance of the quadratus lumborum a communication may be sometimes found between the last dorsal and the first lumbar nerve.

The branches of the sympathetic that join the spinal nerves are to be followed along the lumbar arteries.

and of the nerves joining it;

On the right side the psoas may be left untouched to see at what places the nerves issue from it.

and on right.

Spinal Lumbar Nerves.—The anterior primary branches of the lumbar nerves, except the last, enter into the lumbar plexus. Five in number, they increase in size from the first to the last, and are joined by filaments of the sympathetic near the intervertebral foramina. They supply branches also to the psoas and quadratus lumborum muscles.

Four lumbar nerves enter the plexus, and supply muscles;

The fifth or lowest nerve receives a communicating branch from the fourth nerve, and descends into the pelvis to enter the sacral plexus. After this nerve is joined by the offset from the fourth, the name *lumbo-sacral* is applied to the common trunk.

fifth to the sacral plexus named lumbo-sacral.

The lumbar plexus is formed by loops of communication between the highest four lumbar nerves. Contained in the substance of the psoas, near its posterior part, the plexus increases in size from above downwards, like the individual nerves. Superiorly a connection is found sometimes between the first lumbar and the last dorsal nerve, and inferiorly the large lumbo-sacral cord unites the lumbar and sacral plexuses.

Plexus how formed. Situation. Connections with nerves.

The *branches* of the plexus supply the lower part of the abdominal wall, the fore part of the thigh, and the inner side of the leg; they are six in number, viz.: —

Six branches, viz.

The *ilio-hypogastric branch* is derived from the first nerve, and appears at the outer border of the psoas muscle, near the upper part: this and the following branch are cutaneous nerves of the buttock and the lower part of the trunk. The branch is directed over the quadratus lumborum to the iliac crest, and enters the wall of the abdomen by penetrating the transversalis abdominis. Its termination in the integuments of the buttock and abdomen, by means of an iliac and hypogastric branch, has been already mentioned (p. 468.).

ilio-hypogastric is the first branch. Course in abdomen.

The *ilio-inguinal branch* arises with the preceding from the first nerve, and issues from the psoas nearly at the same spot. Of smaller size than the ilio-hypogastric, this branch courses outwards over the quadratus and iliacus muscles towards the front of the crest of the hip bone, where it pierces the transversalis abdominis. The farther course of the nerve

Ilio-inguinal arises with preceding, and ac-

companies it. in the abdominal wall, and its distribution over the scrotum and the groin, are before noticed (p. 468. 481.).

May be absent. The size of this nerve depends upon that of the ilio-hypogastric branch; and the nerve may be absent if the latter is large.

Genito-crural The *genito-crural nerve* is distributed, as the name expresses, to the genital organs and the limb. It arises from the second lumbar nerve, and from the connecting loop between this and the first: it soon pierces the fibres of the psoas, and descending on the surface of the muscle divides into a genital and a crural branch. Sometimes the nerve is divided in the psoas, and the branches perforate separately the muscle.

pierces psoas,

and divides into

genital and *a.* The *genital branch* descends on the external iliac artery, and furnishes offsets around it; it passes from the abdomen with the spermatic vessels, and is distributed in the cremaster muscle. In the female the nerve is lost in the round ligament.

crural branch. *b.* The *crural branch* issues beneath Poupart's ligament to supply the integument of the thigh. (See Cutaneous Nerves of the Thigh.)

Course of external cutaneous nerve in the abdomen to reach the thigh. The *external cutaneous nerve* of the thigh arises from the second nerve of the plexus, or from the loop between it and the third, and appears about the middle of the outer border of the psoas. The nerve then takes an oblique course across the iliacus to the interval between the anterior iliac spinous processes, and leaves the abdomen beneath Poupart's ligament, to be distributed on the outer aspect of the limb.

Origin of anterior crural nerve. The *anterior crural nerve* is by far the largest offset of the plexus, and supplies branches to the extensor muscles of the knee joint, and the front of the thigh. Taking origin from the third and fourth nerves, and receiving a fasciculus also from the second, this large nerve appears towards the lower part of the psoas, and then lies between that muscle and the iliacus. It passes from the abdomen beneath Poupart's ligament; but before its final branching in the thigh, the nerve furnishes the following twigs: —

Position in the abdomen; its branches here

to iliacus, Some small *branches* are given to the *iliacus* from the outer side of the nerve, whilst it lies in contact with that muscle.

to femo- A *branch to the femoral artery* is distributed around

the upper part of that vessel: its place of origin varies much. ral artery.

The *obturator nerve* appertains to the adductor muscles of the thigh. Derived from the third and fourth nerves in the plexus, it is directed beneath the psoas to the inner or pelvic border; escaped from beneath that muscle the nerve crosses the pelvic cavity below the external iliac, but above the obturator vessels, and enters the thigh through the aperture in the upper part of the thyroid foramen. Occasionally the obturator gives origin to the following branch: —

Obturator nerve in the abdomen; to reach the thigh;

The *accessory obturator nerve* arises near the beginning of the trunk of the obturator, or from the third and fourth nerves of the plexus. Its course is along the inner border of the psoas, beneath the investing fascia, and over the surface of the hip bone to the thigh, where it ends by joining the obturator nerve, and supplying the hip joint.

its accessory branch supplies hip joint.

Gangliated cord of the sympathetic.— The lumbar part of the gangliated cord of the sympathetic in the abdomen is placed on the side of the spinal column, and is continuous upwards beneath the inner arch of the diaphragm with the thoracic part, and downwards with the pelvic part of the same cord. It lies along the inner border of the psoas muscle, nearer the front of the vertebræ than the like part in the thorax, and is somewhat concealed on the right side by the vena cava. Each cord presents four or five oblong ganglia opposite the bodies of the vertebræ; and from these, connecting branches to the spinal nerves, and branches of distribution are supplied.

Sympathetic cord in the abdomen joins that in thorax; has four or five ganglia;

a. Connecting branches. — From each ganglion two small branches are directed backwards, along the centre of the body of the vertebra, with the lumbar artery; these unite with a spinal nerve near the intervertebral foramen, or they are often divided between two spinal nerves. The connecting branches are longest in the lumbar region, in consequence of the cord being carried forwards by the psoas muscle to the fore part of the vertebræ.

their branches to either the spinal nerves

b. Branches for distribution. — Most of the internal branches throw themselves into the aortic and hypogastric plexuses, and so reach the viscera indirectly. Some filaments enter the vertebræ and their connecting ligaments.

or the plexuses for the supply of the viscera.

Last dorsal nerve. — The anterior primary branch of the Last dorsal

nerve is like the inter-costal. last dorsal nerve resembles the other intercostal nerves in its distribution, but differs from them in not being contained in an intercostal space. Lying below the last rib, the nerve is directed outwards across the upper part of the quadratus lumborum, and beneath the fascia covering that muscle. At the outer border of the quadratus it pierces the posterior aponeurosis of the transversalis abdominis (fascia lumborum), enters the wall of the abdomen, and ends in an abdominal and a cutaneous branch (p. 468.). Near the spine it furnishes a small branch to the quadratus muscle; and it may communicate by means of this with the first lumbar nerve. An offset from the first lumbar artery accompanies the nerve.

Course in wall of the abdomen.

Lumbar arteries five in number on each side, like the inter-costal.

The LUMBAR ARTERIES are some of the parietal branches of the aorta (p. 572.), and are furnished to the spinal canal and the wall of the abdomen: they resemble the aortic intercostal branches in their course and distribution. Commonly five in number on each side, these arteries arise opposite the centre of the vertebræ, and the vessels of opposite sides are sometimes joined in a common trunk: they then pass backwards along the fore part of the vertebræ, beneath the pillar of the diaphragm and the psoas, to reach the intervals between the transverse processes, where each ends in an abdominal and a dorsal branch. The arteries of the right side pass beneath the vena cava.

Course and termination in

a branch to the back,

a. The *dorsal branch* continues onwards to the back between the transverse processes, and supplies an offset to the spinal canal. The distribution of the artery is described with the vessels of the back and spinal cord (p. 422. 436.).

and a branch to the wall of the abdomen.

b. The *abdominal branches* are directed outwards beneath the quadratus lumborum, the first being the largest, and enter the posterior part of the abdominal wall, where they anastomose with the lower intercostal, the circumflex iliac, and the ilio-lumbar arteries: these branches supply the psoas and quadratus muscles. The branch of the first, and sometimes that of the last artery, is superficial to the quadratus; and the size of the last two varies with that of the ilio-lumbar offset of the internal iliac artery.

The veins resemble the arteries,

The LUMBAR VEINS are the same in number, and have the same course as the arteries. Commencing by the union of a dorsal and an abdominal branch at the root of the trans-

verse process, the trunk of the vein is directed forwards with the artery to the vena cava. These vessels open into the posterior part of the cava, either singly, or conjointly with those of the opposite side. The veins of the left side are longer than those of the right, and pass beneath the aorta.

and open into the cava; left longest.

Beneath the psoas muscle the lumbar veins communicate freely around the transverse processes with one another, with the ilio-lumbar, and sometimes with the common iliac, so as to form a plexus of veins. Issuing from the plexus on each side is a venous trunk, the ascending lumbar vein, which joins the azygos vein of the corresponding half of the body.

A plexus is formed around the transverse processes.

CAVITY OF THE PELVIS.

Definition of and situation.

The cavity of the pelvis is but a part of the general abdominal space (p. 499.), and is situate below the brim or inlet of the true pelvis.

Boundaries.

Boundaries. — The space is surrounded by the firm bony ring of the pelvic bones, and therefore admits of little alteration in its form or capacity. Behind it is bounded by the sacrum and the coccyx with the sacro-sciatic ligaments, and, laterally and in front by the innominate bones covered by the obturator muscles. Inferiorly, or towards the perinæum, the cavity is limited by the fascia reflected from the wall to the viscera, and by the levatores ani and coccygei muscles: it is only in this last direction, where the bounding structures are moveable, that alterations can be made in the capacity of the space.

Contents.

Contents. — In the interior are contained the urinary bladder, the lower end of the large intestine, or the rectum, and some of the generative organs according to the sex. All these parts have vessels, nerves, and lymphatics distributed to them, and the serous membrane is reflected over them.

Section I.

FASCIA OF THE PELVIS AND MUSCLES OF THE OUTLET.

Outline of the fascia of the pelvis.

On the wall of the pelvis is a thin fascia (pelvic), which extends from the brim to the outlet, and covers the obturator muscle. At a certain level a visceral portion is directed inwards from it to the rectum and the bladder, and this is named recto-vesical fascia from the viscera with which it is connected.

Steps to define the pelvic fascia.

Dissection.— To bring into view the parietal part, or the pelvic fascia, the external iliac vessels, and the psoas if this has not been removed in the dissection of the lumbar plexus, are to be taken away on the left side of the body. The ob-

turator vessels and nerve are to be cut away on the same side; and the peritoneum being detached from the wall of the pelvis, the fascia will be seen on scraping away a large quantity of fat with the handle of the scalpel. But the membrane is now apparent only on its upper half, or as low as the situation of the piece that is prolonged inwards to the viscera; to see its lower half, the student must raise the outlet of the pelvis and look to the fascia covering the outer wall of the ischio-rectal fossa. Should the perinæum be undissected, the fat must be taken from the hollow referred to. If the scalpel be pushed upwards in the fossa, it will enter the pelvis where the visceral joins the parietal piece, and will mark the position of the levator ani muscle between the two.

The *pelvic fascia* is a thin membrane in close contact with the obturator muscle, and is fixed to the bone around the attachment of the fleshy fibres, so that it might be called the special fascia (obturator) of that muscle. Above it reaches the brim of the pelvis for a short distance at the lateral aspect of the cavity; in front of that spot it does not extend so high as the brim, but following the muscle, forms an arch below the obturator vessels; whilst farther to the middle line it is fixed along an oblique line near the lower part of the symphysis pubis. Inferiorly the fascia is attached to the margin of the great sacro-sciatic ligament, and to the side of the pubic arch; but below the pubes it is continued from the one hip bone to the other for a certain distance, so as to join the recto-vesical piece at this spot, and to close the front of the cavity of the pelvis. At a certain level, viz. that of a line prolonged from the lower part of the symphysis pubis to the ischial spine, the fascia sends inwards the recto-vesical piece to the viscera of the pelvis: the origin of this offset is indicated by a whitish band, which marks also the attachment of the levator ani muscle beneath. The outer surface of the fascia is in contact with the obturator muscle. The inner surface, above the origin of the recto-vesical piece, corresponds with the cavity of the pelvis, but below that spot, with the ischio-rectal fossa. At the posterior border of the obturator muscle a thin membrane is continued backwards to the front of the sacrum,

Fascia of the wall of the pelvis.

Its attachment around the obturator muscle;

partly closes aperture of pelvis in front;

gives off recto-vesical piece.

Connections of the fascia.

over the sacral plexus and the pyriformis muscle, but beneath the vessels, by which it is perforated.

Different terms applied to the fascia.

It may be here remarked that the term "pelvic" is not always applied, as in the previous description, to the fascia in its whole extent from the brim to the outlet of the pelvis, but that the name "obturator" is given to the half of it below the recto-vesical piece. Those who make this distinction describe the pelvic fascia as dividing into obturator and recto-vesical layers at the level of the line mentioned.

Recto-vesical layer after.

The *recto-vesical fascia* may be now seen in a measure; but it will be better displayed after the innominate bone has been taken away for the purpose of giving a side view of the pelvis.

How to remove the innominate bone.

Dissection. — To obtain a side view of the pelvis it will be necessary to separate one innominate bone, say the left. The pelvic fascia is first to be detached from the bone and the obturator muscle, but without destroying before and behind the attachments of the white band of the fascia. The innominate bone is then to be sawn through in front rather external to the symphysis; and the lateral articulation with the sacrum is likewise to be sawn through. After the innominate bone has been somewhat separated from the rest of the pelvis, the ischial spine with the pelvic fascia attached to it may be cut off with a bone forceps, and then the rest of the bone may be removed by cutting through the pyriformis muscle, the vessels and nerves passing through the sacro-sciatic notch, and any other structure that may retain the bone.

Preparation of the parts.

A small block is afterwards to be placed beneath the pelvis; the bladder is to be moderately distended with air; and some tow is to be introduced into the rectum, also into the vagina of the female, as well as a small piece into the pouch of the peritoneum between the bladder and the rectum. After the viscera are thus made prominent, the recto-vesical fascia and the ischial spine should be raised with hooks, whilst the surfaces of the levator ani and coccygeus muscles are cleaned.

Outlet of pelvis is closed by

Parts closing the outlet of the pelvis. — In addition to the recto-vesical fascia, the following parts fill the large outlet of the dried pelvis. Beginning behind, the student will first

pyriformis

meet with the pyriformis, passing through the great sacro-

sciatic notch, with the gluteal artery and nerve above it. Next he will come to the coccygeus muscle, with the sacro-sciatic ligament stretched between the ischial spine and the coccyx, one border of the muscle reaching towards the pyriformis, and the other to the levator ani; and between the posterior border and the pyriformis will be the sacral plexus of nerves, and the sciatic and pudic vessels. The greater part of the rest of the space will be seen to be closed by the levator ani, which extends forwards from the coccygeus to the posterior part of the symphysis pubis; it meets its fellow inferiorly, but, in front, the muscles of opposite sides are separated by the urethra and the prostate gland, and the interval between them is closed by the fascia lining the pelvis.

by coccygeus, and sacro-sciatic ligaments, with vessels and nerves;

by levator ani, and by pelvic fascia below the pubes.

The COCCYGEUS MUSCLE is flat and triangular, and assists to close the outlet of the pelvis. It *arises* by a narrow process from the upper part of the ischial spine, and some fibres are attached to the small sacro-sciatic ligament. Widening as it passes inwards, the muscle is *inserted* into the side and anterior surface of the coccyx, and the side of the lower piece of the sacrum. The inner surface looks to the pelvis, and is in contact with the rectum on the left side; the opposite surface rests on the small sacro-sciatic ligament. The hinder border is contiguous to the pyriformis muscle, only vessels and nerves intervening, and the anterior or lower border is parallel with the levator ani muscle and is connected with it.

Coccygeus; origin

and insertion

Connections of surfaces

and borders.

The LEVATOR ANI is a thin flat muscle, which is attached above to the side of the pelvis, and descends below into the outlet of that cavity, where it joins its fellow, and supports the viscera. It *arises* anteriorly by fleshy fibres from an oblique line on the posterior aspect of the pubes, and posteriorly, from the inner surface of the ischial spine; and between those two points of bone the muscle takes origin from the under part of the recto-vesical fascia, along the line of the white band before alluded to (p. 589.). All the fibres are directed downwards to the middle line of the body, to be *inserted* after the following manner: — The anterior, the longest, descend by the side of the prostate and join, anterior to the rectum, with the muscle of the opposite side in the central point of the perinæum; the

Levator ani; situation.

Origin partly from bone, and partly from membrane.

Insertion along middle line of the perinæum.

middle fibres blend with the side of the rectum; whilst the posterior meet the opposite muscle behind the gut, and are attached in part to the side of the coccyx, as before described in the dissection of the perinæum (p. 447.). The anterior fibres of the levator are in contact with the fascia that closes the pelvic cavity below the pubes, and the posterior are parallel to the coccygeus muscle. The upper surface is contiguous to the recto-vesical fascia, and the viscera of the pelvis; and the under surface looks to the perinæum (ischio-rectal fossa). The two muscles, by their union, form a fleshy layer or diaphragm across the outlet of the pelvis, similar to that which separates the abdomen from the chest: this partition is convex below and concave above, and gives passage to the rectum. In front there is an interval between the anterior fibres, which allows the urethra, together with the vagina in the female, to pass from the pelvis.

Borders and surfaces.

Two muscles form a fleshy diaphragm.

Anterior fibres named levator prostatæ.

The anterior part of the muscle that descends by the side of the prostate, and unites with its fellow below the membranous part of the urethra, thus supporting that canal as in a sling, has been named *levator seu compressor prostatæ.*

Dissection for the recto-vesical fascia.

Dissection. — The recto-vesical fascia will be seen by detaching the fleshy fibres of the levator ani at their origin, and the coccygeus muscle from the ischial spine, and throwing both downwards. Below the spot at which the fascia reaches the side of the prostate gland and the rectum, it gives sheaths to those viscera; and to demonstrate these sheaths one incision is to be made along the prostate, and another along the lower end of the rectum, below the attachment of the fascia.

Recto-vesical fascia arises from pelvic fascia, and is reflected on to the viscera, supporting them.

The *recto-vesical fascia* is derived from the pelvic fascia, and supports and partly invests the viscera of the pelvis. Arising, as before said, on a level with the band that extends from the pubes to the ischial spine, the fascia is directed inwards on the levator ani, and has the following disposition on the viscera: — In the middle line in front it is continued from the back of the pubes to the apex and the upper surface of the prostate; here it closes the pelvis before the levatores ani, and forms on each side of the middle line a roundish band, the anterior ligament of the bladder. More to the side, the fascia is attached to the lateral part of the prostate and to the side of the bladder, giving rise to the

lateral vesical ligament. And still farther back it reaches the side of the rectum. The fascia does not cease, where it meets the viscera, by becoming blended with their coats, but is continued downwards around the prostate and the rectum, so as to form sheaths for those viscera below the level of its attachment to them. The sheath that is prolonged on the gut becomes thin towards the anus; whilst that on the prostate is separated from its viscus by a plexus of veins (prostatic), and sends an offset backwards to incase the vesiculæ seminales. The recto-vesical fascia forms a partition, like that of the levatores ani muscles, across the pelvis, which is perforated by the prostate and the rectum; but in the case of the fascia the viscera receive sheaths from the membrane as they pass through it.

It gives sheaths to the prostate and rectum,

and forms part of the floor of the pelvis.

In the female the fascia has much the same arrangement as in the male; but the vagina, instead of the prostate, perforates the membrane, and receives a tube from it.

Fascia in the female.

The *true ligaments of the bladder* are two on each side, anterior and lateral, and are derived from the recto-vesical fascia.

Pieces of the fascia

a. The *anterior* reaches from the posterior aspect of the pubes to the upper surface of the prostate, and the neck of the bladder: it is a narrow white band, and encloses some muscular fibres of the bladder. Between the ligaments of opposite sides, the recto-vesical fascia dips down to reach the apex of the prostate.

form the anterior

b. The *lateral ligament* is a piece of the same fascia, which is fixed to the lateral part of the prostate gland, at the upper border, and to the side of the bladder on the same level.

and lateral ligaments of the bladder.

There are other ligaments of the bladder (false ligaments), which are derived from the peritoneum investing it, and will be seen in the following section.

False ligaments of bladder.

Section II.

CONNECTIONS OF THE VISCERA IN THE MALE.

Directions.— If the student should be dissecting a female pelvis, he will find the description of it at page 601.

Dissection of female pelvis.

Contents and *position.*— The viscera in the cavity of the male pelvis are the lower end of the large intestine (rectum);

Contents of the pelvis.

the bladder with its excretory tube — the urethra; together with some generative organs, viz. the seminal vesicles and their ducts. These have the following relative situation: —

Outline of their position. The rectum is behind all, and takes a curved course, with the convexity backwards, along the front of the sacrum and the coccyx. The bladder is placed in the concavity of the rectum, its neck being surrounded by the prostate gland; and the urethra curves forwards from it above the tube of the intestine. Beneath the bladder — that is to say, between it and the rectum, — are the little seminal sacs with their ducts. Some of these organs are partly surrounded by the peritoneum.

Take away fascia and some vessels. *Dissection.* — All the recto-vesical fascia, except the anterior ligament of the bladder, may be now taken from the viscera. The obliterated remnant of the internal iliac artery (hypogastric) should be next followed forwards, along the bladder, from the back of the pelvis; but the other branches of the same artery to the lower limb are to be cut through. When the fat and the vessels have been cleared away, the pouch of the peritoneum, in which wool has been placed, will be brought into view, with the ureter passing to the bladder.

The several viscera are to be cleaned. The prostate may be now cleaned, and the vesiculæ seminales which are behind it defined: the part of the bladder below the peritoneum is likewise to be prepared, and at the same time the vas deferens, which lies on the lateral aspect of that viscus, is to be followed down to the seminal sacs. Lastly, the layer of fascia is to be removed from the part of the rectum below the peritoneum, but the branches to the gut from the inferior mesenteric artery are to be preserved. If the bladder has become flaccid, half fill it with air, in order that its connections may be studied.

The peritoneum The *peritoneum* does not envelop the viscera of the pelvis so completely as those of the upper part of the abdomen. After partly surrounding the upper portion of the rectum, covers partly the rectum and fixing it by a process — *meso-rectum,* the membrane can be traced to the back of the bladder, where it projects for some way between this viscus and the rectum, forming the recto-vesical pouch. On each side of the rectum the serous membrane is arrested by the internal iliac artery, and gives rise to a fold, the posterior ligament of the bladder. Tracing

the peritoneum upwards on the bladder, the student will find it covering all the posterior surface; and the posterior part of each lateral region, as far forwards as the position of the obliterated hypogastric artery, but at that vessel it is reflected from the sides and summit of the bladder to the wall of the pelvis and abdomen. All the anterior surface of the bladder is therefore uncovered by peritoneum; and when the bladder is distended it rises above the pubes so as to allow of its being opened in front without injury to the serous membrane.

and partly the bladder,

leaving front and lower part uncovered.

The *recto-vesical pouch* is wide behind, where it corresponds with the interval between the iliac arteries, and is narrow in front between the rectum and the bladder. Anteriorly it extends as far as, or even into the interval between the vesiculæ seminales; it ends usually about one inch and a half from the tip of the coccyx, but sometimes it reaches the prostate gland. The distance of the pouch from the anus is commonly about four inches; but this will vary with the state of the bladder, for if this viscus is distended the pouch of the peritoneum will be raised with it, and removed therefore farther from the end of the intestine.

The pouch between the rectum and bladder.

Extent forwards and distance from the anus vary.

False ligaments of the bladder. — Where the peritoneum is reflected from the bladder to the wall of the cavity, it gives rise to the false ligaments of that viscus. These are five in number: — two posterior, two lateral, and one superior.

Folds of it, false ligaments of the bladder, viz. —

The *posterior* ligament (one on each side) reaches from the back of the pelvis to the bladder, and contains the obliterated hypogastric artery, the ureter, and some vessels and nerves. Between these is the hollow of the recto-vesical pouch.

two posterior,

The *lateral ligament*, also one on a side, is a wide piece of peritoneum, which is reflected from the side of the bladder to the iliac fossa, and the wall of the pelvis. Along its line of attachment to the bladder is the obliterated hypogastric artery.

two lateral,

The *superior ligament* is reflected from the upper part of the bladder to the abdominal wall, along the same obliterated vessel.

and one superior.

The RECTUM, or the lower part of the great intestine, extends from the articulation between the sacrum and the hip

Extent of the rectum,

bone to the anus, and is kept in place by the peritoneum and the recto-vesical fascia. The intestine is about eight inches long, and takes a winding course, for it follows the curve of the sacrum and coccyx; it is divided into three parts, upper, middle, and lower.

length, and divisions.

First piece most covered by peritoneum.

The *upper part,* longer than the others, extends obliquely from the sacro-iliac articulation to the centre of the third piece of the sacrum. It is surrounded almost entirely by the peritoneum which forms the meso-rectum behind it: it lies against the sacrum, and on the pyriformis muscle and the sacral plexus of the left side. In contact with its left side are the branches of the internal iliac artery, and the left ureter. In some bodies this part of the intestine is much curved to the right side.*

Middle piece only covered in front.

The *middle piece* lies beneath the bladder, and reaches to the tip of the coccyx: it is about three inches in length, and is covered by peritoneum on the upper aspect for about two thirds of its extent. Resting on it is the lower or triangular part of the bladder, with the vesiculæ seminales and vasa deferentia; and behind it is the bone. On the left side is the coccygeus muscle.

Last piece is uncovered.

The *lower part* is about an inch and a half in length, and is covered from the tip of the coccyx to the anus: at first it is much dilated, but at the anus it is contracted. This end of the intestine is without peritoneal covering, and is supported by the lower part of the triangular ligament of the urethra, and by the levatores ani muscles. Above the extremity of the rectum (in this position of the body) are the prostate, the membranous part of the urethra, and the bulb of the same tube; but as the gut gradually recedes from the urethra there is an angular interval left between the two. The levatores ani muscles descend on its sides, and unite beneath it, supporting it in a sling; and the sphincter muscles surround the aperture. Sometimes this end of the

Connections with parts around.

Some-

* In the dissecting-room of the College (Session 1854—1855) I saw three examples of the rectum being placed on the right side of the sacrum. In two bodies the lower end of the left colon crossed the spine, at the top of the sacrum, and the rectum descended through the pelvis, on the right of the middle line, to the end of the coccyx: in the third it crossed the spine twice, once at the top of the sacrum, and again at about the middle of that bone.

intestine is very much enlarged, especially in women or old men; and it then rises up on each side of the prostate in the latter, so as to surround this viscus except above.

times dilated.

The URINARY BLADDER (vesica urinaria) is situate in the pelvis, and is the receptacle for the fluid secreted by the kidneys. When the bladder is contracted it is of a triangular form, and lies within the pelvis against the anterior wall of the cavity. But when it is distended it becomes of a conical shape, with the larger part directed towards the rectum, and the apex to the abdominal wall; and it is slightly curved over the anterior part of the pelvis as it projects beyond the bone. If a line through its centre were prolonged, it would touch the abdominal wall somewhere (according to the distension) between the umbilicus and the pubes in the one direction, and the end of the coccyx in the other direction. The organ is maintained in its position by the recto-vesical fascia and the peritoneum, which form its ligaments (p. 593. 595.).

Bladder is in pelvis when empty,

and projects above when full.

Axis.

For the purpose of studying its connections the bladder is divided into the following parts: — a summit and base, and a body and neck.

Divisions.

The *summit* or apex of the bladder is rounded, and from its anterior part three ligamentous cords are prolonged to the umbilicus: the central one of these is the remnant of the urachus, and the two lateral are formed by the obliterated hypogastric arteries. If the bladder is full, the apex is above, but otherwise below the pubes. All the surface behind the obliterated vessels is covered by peritoneum.

Apex has cords on it.

The *base* (fundus) is large, and rests on the middle piece of the rectum. In the state of emptiness of the bladder the base is scarcely prominent; but in distension of the viscus, this part extends lower, and becomes widened. Connected with the under part of the bladder are the vesiculæ seminales and the vasa deferentia; and between these is a triangular space, from which the peritoneum is absent.

Base

alters in shape;

parts in contact with it.

Surfaces of the body. — The anterior part of the bladder is in contact with the posterior surface of the symphysis pubis, or with the lower part of the abdominal wall if it is distended, and is altogether free from peritoneum; whilst the posterior surface, on the other hand, is entirely covered

Surfaces: anterior

and posterior;

lateral. by serous membrane. Extending along the upper part of each lateral region is the obliterated hypogastric vessel, and crossing it lower down is the vas deferens; near the under part is the entrance of the ureter into the bladder. All the side of the bladder behind the obliterated vessel is covered by peritoneum, but the rest is uncovered.

Neck. The *neck* (cervix) is the narrow anterior part of the bladder that joins the urethra. It is surrounded by the prostate gland.

Position in pelvis varies with age. The position of the bladder in the pelvis is not the same in adult as in early life. For in the child this viscus projects above the brim of the pelvis into the hypogastric region of the abdomen, and the cervix is the lowest part. But in the adult the bladder is contained within the space enclosed by the larger pelvic bones, and the base or fundus projects inferiorly.

Ureter in pelvis, The *ureter* enters the posterior ligament of the bladder, after crossing the common or the external iliac artery, and forms an arch below the level of the obliterated hypogastric and entrance into bladder. vessel; it reaches forwards to enter the bladder near the lower part, and somewhat on the side, at the distance of about two inches from the prostate gland.

Position of the prostate; The PROSTATE GLAND surrounds the neck of the bladder. It is placed below the level of the symphysis pubis, as well form; as posterior to it, and is supported by the rectum. Its shape is that of a cone with the base turned backwards, and its axis; size equals nearly a large horse chesnut. In the present position of the pelvis, a line through the middle of the gland would be directed obliquely downwards and backwards, though, in the erect state of the body, it would be almost horizontal.

upper surface; The *upper surface* is about three quarters of an inch below the symphysis pubis, and is connected to it by the anterior ligaments of the bladder. On this aspect are branches of the dorsal vein of the penis.

under surface. The *under surface* has the greatest extent, and is contiguous to the rectum; this is the part that is felt by the finger introduced into the bowel through the anus.

Apex and base. The *apex* touches the fascia of the pelvis that closes the upper part of the subpubic arch; and the base surrounds

the vesiculæ seminales with the vasa deferentia, and limits anteriorly the triangular space at the base of the bladder.

The prostate is enveloped by a sheath obtained from the recto-vesical fascia (p. 592.), and a plexus of veins (prostatic) surrounds it: through the middle of the gland the urethra takes its course to the penis. The size of the prostate alters much with increasing age, and in old people it may acquire a considerable magnitude. It is contained in a sheath; size may increase.

The VESICULÆ SEMINALES are two small sacculated bodies, each about two inches long, between the under part of the bladder and the rectum. Each is pyramidal in form, and has the larger end turned backwards towards the ureter, whilst the smaller is surrounded by the prostate. Along the inner side is the vas deferens. At the prostate gland the vesiculæ are close together; but farther backwards they diverge from one another, and enclose with the pouch of the peritoneum a triangular space at the under aspect of the bladder. The vesiculæ are contained in a membranous sheath, which is derived from the recto-vesical fascia. Seminal vesicles; their connections.

The VAS DEFERENS or the excretory duct of the testis, in its course to the urethra, enters the abdomen by the internal abdominal ring, and is then directed inwards along the side and under part of the bladder to the base of the prostate, where it forms the common ejaculatory duct by joining with the duct from the vesicula seminalis. The position of this tube to the external iliac artery has been noticed; on the bladder it may be seen to cross the obliterated hypogastric artery, and to pass internal to the ureter and the vesicula of the same side. By the side of the vesicula the duct is much enlarged, and is sacculated. Vas deferens; course; unites with duct from vesicula.

The URETHRA is the excretory passage for the urine and semen, and reaches from the bladder to the end of the penis. Its length varies from seven and a half to eight inches and a half, and it presents one or two curves according to the state of the penis. At first the canal is directed forwards and upwards, through the triangular ligament of the perinæum, to the body of the penis, forming a large curve with the concavity to the pubes. Thence to its termination the urethra is applied to the penis; and whilst this body remains pendent it forms a second bend with the concavity downwards, but if the penis is raised, the canal makes but one curve through- The urethra; length; it is curved according to the condition of the penis;

its divisions. out. The canal is divided into three parts, prostatic, membranous, and spongy.

Prostatic. The *prostatic part* is contained in the prostate gland, and receives its name from that circumstance. Its length and connections are the same as those of the gland (p. 598.).

Membranous; The *membranous part* is nearly an inch long, and intervenes between the apex of the prostate and the front of the perinæal triangular ligament. It is somewhat curved upwards, and the bulb of the next portion of the urethral tube is directed backwards below it, so that the under part appears connections. to measure less than the upper. Surrounding it are the muscular fibres of the constrictor urethræ; close below it are Cowper's glands, and beneath or behind it is the rectum. This division of the urethra is the weakest; but it is supported by the triangular ligament.

Spongy. The *spongy part* is so named from its being surrounded by a cellular and vascular structure. It is applied to the body of the penis assisting to form this, and terminates anteriorly in the orifice named meatus urinarius in the end of the glans. It is the longest part of the urethra, and measures about five inches. At its commencement this division of the excretory canal is surrounded by the ejaculator urinæ muscle.

Dissection. *Dissection.*— All the tegumentary covering of the penis may be removed, to see the component parts of that body: and after its removal the spongy part of the urethra will be better seen.

Constituents and situation of the penis. The PENIS is a cylindrical body, which is attached to the fore part of the pelvis, and depends from it in front of the scrotum. It is constructed of two firm fibrous bodies named corpora cavernosa, which form the principal part of the organ; and below these is a soft spongy substance (corpus spongiosum) that surrounds the urethra, and forms the head or the glans penis. A tegumentary investment covers the whole, and is supplied with vessels and nerves; these are noticed at p. 470.

Corpora cavernosa form body of penis, The *corpora cavernosa* form the bulk of the penis, and are two dense, fibrous, almost cylindrical tubes, which are filled with a vascular texture. Each is fixed posteriorly to the upper part of the pubic arch for about an inch by a thick pointed process, the *crus penis;* and after a distance of an inch and a half it is blended with its fellow in the

body of the penis. Near its junction with its fellow there is a slight swelling on the crus — the bulb of the corpus cavernosum (Kobelt). The *body* of the penis, formed by the union of the corpora cavernosa, is grooved above and below along the middle line, and presents anteriorly a narrowed but truncated extremity that is covered by the glans penis; along its under surface the urethra is conducted. Besides the attachment of the corpora cavernosa by the crura, the body of the penis is connected with the front of the symphysis pubis by the suspensory ligament.

but each is separate behind.

Form and attachment of penis.

The *corpus spongiosum urethræ* encloses the urethral canal, and forms the head of the penis. It is a vascular and erectile texture, like the corpora cavernosa, but is much less strong. Commencing posteriorly by a dilated part — the bulb, this structure extends forwards around the urethra to the extremity of the penis, where it swells out into the conical glans penis.

Corpus spongiosum surrounds urethra, and swells into

The *bulb* is in front of the triangular ligament of the urethra, and opposite the point of junction of the crura of the corpora cavernosa. It is directed backwards slightly below the membranous part of the urethra, and is fixed by fibrous tissue to the front of the triangular ligament. The accelerator urinæ muscle covers it. The enlargement presents usually a central depression, with a bulging on each side, and is subdivided into two lobes.

the bulb, which is lobed,

The *glans penis* is somewhat conical in form, and covers the truncated end of the corpora cavernosa. Its base is directed backwards, and is marked by a slightly prominent border — the *corona glandis;* it is also sloped obliquely along the under aspect, from the apex to the base. In the apex is a vertical slit, in which the urethral canal terminates; and below that aperture is an excavation which contains the frænum preputii.

and the conical glans penis.

Section III.

CONNECTIONS OF THE VISCERA IN THE FEMALE.

In the pelvis of the female are contained the lower end of the intestinal tube, and the bladder and the urethra, as in the male; but there are in addition the generative organs, viz. the uterus with its accessories, and the vagina.

Contents of the female pelvis,

and their situation.

Position. — The rectum is posterior to the rest as in the male pelvis, and forms a like curve. In the concavity of the bent intestine lie the uterus with its appendages, and the tube of the vagina. And in front of these are the bladder and the urethral canal. In this sex there are three tubes connected with the viscera, and all are directed forwards, one above another, to the surface, viz. the tube of the urethra, that of the vagina, and that of the rectum.

Use description of male pelvis.

Directions.— The description in Section I. (p. 588.) of the male pelvis must be used for instructions respecting the removal of the innominate bone, and for the anatomy of the fasciæ, and the muscles of the outlet of the pelvis.

After the student has learnt, as directed above, the fasciæ and the muscles, which are nearly alike in both sexes, he may make the following special dissection of the viscera of the female pelvis.

Then clean the viscera of the female pelvis.

Dissection. — On taking away the recto-vesical fascia and much fat, the several viscera will come into view. To maintain the position of the uterus, this may be held up with a piece of string passed through the upper part. The reflections of the peritoneum on the viscera are to be preserved, and a piece of cotton wool is to be placed between the rectum and the uterus. The obliterated part of the internal iliac artery is to be followed forwards to the bladder, but all the other branches may be cut away on this the left side ; the ureter will be found passing to the bladder close to that artery. Afterwards the urethra, the vagina, and the rectum are to be cleaned and partly separated from one another at the anterior part of the pelvis, but the arteries on the rectum are to be preserved.

Reflections of the peritoneum.

The *peritoneum* gives a partial covering to the viscera, as in the male pelvis. Investing the upper part of the rectum, and forming behind it the meso-rectum, the membrane is continued for a short distance on the front of the intestine to the posterior part of the vagina, and the back of the uterus. It covers the posterior, and the greater part of the anterior surface of the uterus, and can be traced to the bladder without again touching the vagina. On each side of the uterus it forms a wide fold (broad ligament), which attaches that viscus to the wall of the abdomen and pelvis. As the peritoneum is followed upwards to the wall of the

abdomen, it will be found to cover the posterior surface of the bladder, and the part on each side behind the position of the obliterated hypogastric artery. In the female the pouch between the rectum and the bladder can scarcely be said to exist, because the vagina intervenes between the two, and arrests, so to express it, the passing forwards of the peritoneum. In the pelvis the serous membrane forms the following ligaments for the uterus and bladder: —

Folds or ligaments are — broad ligament of the uterus,

The *broad ligament of the uterus* passes from the side of the uterus to the wall of the abdomen, and supports that organ in the cavity of the pelvis. By its position across the pelvis, it divides the cavity into an anterior and a posterior part: in the former are placed the bladder, urethra, and vagina; in the latter the upper part of the rectum, and the small intestine when it reaches the pelvis. Each ligament shows traces of a subdivision into three pieces, corresponding with the bodies contained between its two layers: thus there is a posterior piece that belongs to the ovary and its ligament; an anterior, near the upper part, which is appropriated to the round ligament; and a middle piece, the highest of all, that surrounds the Fallopian tube. It is at the free extremity of the Fallopian tube that the peritoneum is continuous with a mucous membrane.

which is subdivided into three parts;

and anterior ligament.

Between the neck of the uterus and the back of the bladder is a small fold on each side, which is sometimes described as the *anterior ligament* of the uterus.

Five ligaments of the bladder.

The *false ligaments of the bladder* are the same as in the male, and are five in number, viz. two posterior, two lateral, and a superior: they are all blended in one large piece of peritoneum that reaches from the bladder to the side and the front of the pelvis. In the female the posterior ligament, containing the ureter and the vessels of the bladder, is less marked than in the male, because the uterus intervenes and pushes aside the vessels.

Connections of the rectum, viz.

The RECTUM is not so curved in the female as in the male, and is generally larger. Descending along the middle of the sacrum and coccyx to the anus, the intestine is divided into three parts: —

of upper,

The *first part* extends to the third piece of the sacrum, and is enveloped by the peritoneum, except posteriorly: its connections are similar to those of the rectum in the male.

middle, The *middle part* reaches to the tip of the coccyx, and has the vagina above and in contact with it. The peritoneum covers the front for a very short distance.

and lower part. The *lower part* curves to the anus away from the vagina so as to leave between the two a space which corresponds, on the surface of the body, to the part of the perinæum between the anus and the vulva. The levatores ani are on the sides, and unite below it, and the sphincter muscles surround the extremity.

Uterus; form and situation. The UTERUS is somewhat of a conical shape, and is flattened from before backwards. It is situate in the pelvis between the bladder and the rectum, and is retained in place by the broad ligaments. Its wider end is free and placed upwards, and the lower end communicates with the vagina: Position to the brim of pelvis. unless enlarged, it lies below the brim of the pelvis. This viscus is tilted forwards, so that its position is oblique in the cavity of the pelvis; and a line through the centre of Axis. the organ would correspond with the axis of the inlet of the pelvic cavity, but not with that of the vagina.

Surfaces. The *anterior surface* is covered by peritoneum, except in the lower fourth, where it is in contact with the bladder. The *posterior surface* is altogether invested by the serous membrane.

Extremities. The *upper end* (fundus vel basis uteri) is the largest part of the organ, and is in contact with the small intestine. The *lower end*, or the neck (cervix uteri) is received into the vagina.

On the side are To each *side* are attached the broad ligament with the Fallopian tube, the round ligament, and the ovary.

Fallopian tube, *a.* The *Fallopian tube* is contained in the free border of the ligament; one end is connected to the upper angle of the uterus, whilst the other is loose in the cavity of the pelvis. At its attachment to the uterus the tube is of small size, but at the opposite extremity it is dilated, like the end of a trumpet, and fringed, forming the corpus fimbriatum.

round ligament, *b.* The *round* or suspensory *ligament* is a fibrous cord, which is directed outwards through the internal abdominal ring and the inguinal canal to the groin. This cord lies over the obliterated hypogastric, and the external iliac artery; and is surrounded by the peritoneum, which accompanies it a short way into the canal.

and the ovary and its ligament.

c. The *ovary* is placed nearly horizontally, and bulges at the posterior aspect of the broad ligament; it is connected to the uterus at the inner end by a special fibrous band, *ligament* of the ovary. Its form is oval, and its margins are turned forwards and backwards. Its size is very variable.

Vagina: extent and form; length; axis; connections. Lower end partly closed

The VAGINA is the tube by which the uterus communicates with the exterior of the body. It is somewhat cylindrical in shape, though flattened on the front and back; and its length is from four to five inches. The vagina is slightly curved as it follows the bend of the rectum, and its axis therefore corresponds at first with the centre of the outlet, but higher up with that of the cavity of the pelvis. In front the vagina is in contact with the base of the bladder, and the urethra; and beneath or below it is the rectum. To the side is attached the recto-vesical fascia, which sends a sheath along the lower half of the tube. The upper end receives the neck of the uterus by an aperture in the anterior or upper wall; and the lower end is the narrowest part of the canal, and is surrounded by the sphincter vaginæ muscle. In children, and in the virgin, the external aperture is closed by the hymen. The vagina is surrounded by a large plexus of veins.

Bladder resembles that of the male.

The BLADDER is placed at the anterior part of the pelvis, above the vagina and in contact with the back of the pubes. Its form, position, and connections so closely resemble those of the bladder in the male body, as to render unnecessary the repetition of them (see p. 597.). The chief differences in the bladder of the two sexes are the following: —

Differences in the two sexes.

In the female the bladder is larger than in the male, and its transverse exceeds its vertical measurement. The base is of less extent; it is in contact with the vagina and the lower part of the uterus; and it does not project below the level of the urethra, so as to form a pouch as in the male. On the side of the viscus there is not any vas deferens; and the prostate is absent from the neck.

Course of ureter.

The *ureter* has a longer course in the pelvis of the female than in that of the male, before it reaches the bladder. After crossing the internal iliac vessels, it passes by the neck of the uterus ere it arrives at its destination.

Urethra; length and form;

The *urethra* is a small narrow tube about one inch and a half long, which curves slightly below the symphysis pubis, the concavity being upwards. Its situation is above the

connections with parts around. vagina, and its external opening is placed within the vulva. In its course to the surface it is imbedded in the tissue of the vaginal wall, and perforates the triangular ligament of the perinæum; but before reaching the last structure it is surrounded by the muscular fibres of the constrictor and orbicularis urethræ (p. 463.). A plexus of veins surrounds the urethra as well as the vagina.

Section IV.

VESSELS AND NERVES OF THE PELVIS.

This section is to be used by the dissectors of both the male and the female pelvis.

Vessels and nerves of the pelvis. In the pelvis are the internal iliac vessels, and their branches to the viscera; the sacral nerves and the sacral plexus; and the sympathetic nerve, consisting of both a gangliated cord, and offsets of the hypogastric plexus.

Directions.—The internal iliac vessels are to be dissected on the right side. But the air should be previously let out of the bladder, and this viscus and the rectum, together with the uterus and the vagina in the female, should be drawn from their situation in the centre of the pelvis.

To dissect the vessels of the pelvis. *Dissection.*—The peritoneum and the loose tissue and fat are to be removed from the viscera and the trunks of the vessels, as well as from the branches that leave the pelvis or supply the viscera; and the obliterated cord of the artery is to be traced on the bladder to the umbilicus. With the Nerves. vessels are offsets of the hypogastric plexus of nerves, but, in the present state of the body, these will probably not be seen; and in dissecting the vessels to the bladder and the rectum, branches of the spinal sacral nerves will come into Veins. view. The veins in a general dissection may be removed to make clean the arteries. When the vessels are quite prepared the bladder may be again distended, and the viscera replaced.

Destination of internal iliac artery; The internal iliac artery is one of the trunks resulting from the division of the common iliac vessel, and furnishes branches to the viscera and the wall of the pelvis, to the generative organs, and to the thigh.

size and length; In the adult the vessel is a short trunk, of large capacity, which measures about an inch and a half in length. Directed

downwards, as far as the sacro-sciatic notch, the artery terminates in two large branches, from which the several offsets are furnished. From the extremity a partly obliterated vessel (hypogastric) extends forwards to the bladder. In entering the pelvis the artery lies in front of the lumbo-sacral nerve and the pyriformis muscle, and is contained in the fold of peritoneum forming the posterior ligament of the bladder. It is accompanied by the internal iliac vein, which is posterior to it, and somewhat on the outer part on the right side. termination; position of vein; connections.

The *branches* of the artery are numerous, and arise usually in the following manner:— from the posterior division of the trunk arise the ilio-lumbar, lateral sacral, and gluteal branches; and from the anterior division come the vesical (upper and lower) obturator, sciatic, and pudic; and, in the female, the uterine and vaginal branches. Branches.

Artery in the fœtus. — In the fœtus the internal iliac becomes the *hypogastric artery*, and leaves the abdomen by the umbilicus. At that time it is larger than the external iliac artery; and, entering but slightly into the cavity of the pelvis, it is directed forwards to the back of the bladder, and then upwards along the side of that viscus to the apex. Beyond the bladder the vessel ascends along the posterior aspect of the abdominal wall with the urachus, converging to its fellow; at the umbilicus the vessels of opposite sides come into contact with the umbilical vein, and, passing from the abdomen through the aperture at that spot, enter into the placental cord, and receive the name *umbilical.* In the fœtus, as in the adult, similar branches are furnished by the artery, though their relative size at the two periods is very different. Condition of the artery in the fœtus,

Change to adult state. — When uterine life has ceased the hypogastric artery diminishes in consequence of the arrest of the current of blood through it, and finally becomes obliterated more or less completely as far back as an inch and a half of its commencement, only a cord remaining in the position of the former vessel. Commonly, the cord remains pervious by means of a very small canal as far as the upper part of the bladder, and gives origin to the vesical arteries. and its transformation into that of the adult.

Peculiarities.—The *length* of the internal iliac artery varies from half an inch to three inches, its extreme measurements; but in two Trunk varies in length,

thirds of a certain number of bodies (Quain) it ranged from an inch to an inch and a half. The increased and diminished extent of the internal, is dependent upon the shortening and lengthening of the common iliac artery.

and in the spot at which it ends.

The *ending* of the vessel may be at any spot between the usual place of origin and termination.

Branches of the posterior trunk.

The branches arising from the posterior division of the internal iliac, are, ilio-lumbar, lateral sacral, and gluteal.

Ilio-lumbar has an

1. The *ilio-lumbar branch* passes outwards beneath the psoas muscle and the obturator nerve, but in front of the lumbo-sacral nerve, and divides into an ascending and a transverse branch in the iliac fossa.

ascending and

a. The ascending or *lumbar* offset, which is beneath the psoas, supplies that muscle and the quadratus lumborum, and anastomoses with the last lumbar artery: it sends a small *spinal* branch through the foramen between the sacrum and the last lumbar vertebra.

a transverse branch.

b. The transverse or *iliac* part divides into branches that ramify in the iliacus muscle, some running over and some beneath it. At the iliac crest these branches anastomose with the lumbar and circumflex iliac arteries; and some twigs from the deep branches communicate with the obturator artery, and enter the innominate bone.

Lateral sacral arteries

2. The *lateral sacral branches* are two in number, superior and inferior, but the upper is the largest; they correspond in situation with the lumbar arteries, and form a chain of anastomoses by the side of the apertures in the front of the sacrum. These branches supply the pyriformis and coccygeus muscles, and anastomose with the foregoing, as well as with the middle sacral branch. A small *spinal branch* enters the spinal canal through each aperture in the sacrum.

supply spinal branch.

Gluteal artery.

3. The *gluteal artery* is a short thick trunk, which appears to be the continuation of the posterior division of the internal iliac. Its destination is to the gluteal muscles on the dorsum of the innominate bone, and it is transmitted from the pelvis above the border of the pyriformis muscle, with its accompanying vein and the superior gluteal nerve.

Small offsets.

In the pelvis this artery gives small *branches* to the contiguous muscles, viz. the iliacus, pyriformis, and obturator, and a nutritious artery to the hip bone.

The branches from the anterior division of the internal iliac artery are the following: — Branches of the anterior trunk.

1. The *vesical arteries* are named superior and inferior, and are distributed to the upper and lower parts of the bladder. Vesical arteries;

a. The *upper vesical* are three or four in number, and arise at intervals from the partly obliterated hypogastric trunk; the lowest is sometimes called middle vesical branch. Offsets are distributed from these branches to all the body and the upper part of the bladder. three or four upper,

b. The *lower vesical* artery arises from the front of the internal iliac in common with a branch to the rectum, or with one to the vagina in the female. It is distributed to the base of the bladder, the vesiculæ seminales, and the prostate. A small offset from this artery, or from the upper vesical, is furnished to the vas deferens, and ascends on it as far as the inguinal canal. and a lower,

2. The *branch to the rectum* (middle hæmorrhoidal) is commonly supplied by the inferior vesical, as before said, or by the pudic. It ramifies on the anterior and lower part of the rectum, and on the vagina in the female, and anastomoses with the superior and inferior hæmorrhoidal arteries. with an offset to the rectum.

3. The *obturator artery* is distributed outside the pelvis, and merely crosses this cavity to reach the aperture of exit. The branch springs usually from the anterior division of the internal iliac artery, and is directed forwards below the brim of the pelvis to the aperture in the upper part of the thyroid foramen. Passing from the pelvis by that opening, the artery ends in two branches, which join on the membrane closing the thyroid foramen, and lie beneath the muscle in that spot. In the pelvis the artery has its companion nerve above, and vein below it, and it distributes the following small branches: — Obturator artery courses across pelvis. Offsets in pelvis;

a. Iliac branch. — Amongst other small offsets, the obturator furnishes a twig to the iliac fossa to supply the bone and the iliacus muscle; this anastomoses with the ilio-lumbar artery.

b. The *pubic branch*, arising as the artery is about to leave the pelvis, ascends on the posterior aspect of the pubes, and communicates with the corresponding branch of the opposite side, as well as with an offset sent downwards from pubic branch.

the epigastric artery. There may be more than one branch to the pubes.

Its origin from epigastric, or iliac, or from both.

Peculiarities. — The obturator artery may arise at the front of the pelvis, from the epigastric instead of the internal iliac, and turn down almost vertically to the thyroid aperture. Or, it may arise by two roots, one from the epigastric, another from the internal iliac, the roots varying in size in different instances: thus they may be nearly equal in size; that from the internal iliac may be the larger of the two; or that from the epigastric may be the largest. The position of the obturator to the internal crural ring, in the instances of its origin from the epigastric, has been before alluded to (p. 498.).

From external iliac.

In some bodies, the obturator may be found to take origin from the external iliac artery.

Frequency of the different origins.

An account of the frequency with which these different peculiarities occur, will be found in Mr. Quain's work on the "Anatomy of the Arteries." Suffice it to say here, that the origin from the internal iliac is the most frequent; that from the epigastric next; and the origin from the two sources, or from the external iliac artery, the least frequent.

Sciatic artery in the pelvis, and outside it.

4. The *sciatic artery* is the next largest branch to the gluteal; it is distributed to the buttock, and may be considered the offset by which the internal iliac artery terminates. The artery is continued over the pyriformis muscle and the sacral plexus to the lower part of the sacrosciatic notch, where it leaves the pelvis between the pyriformis and the coccygeus. External to the pelvis it divides into branches beneath the gluteus maximus muscle. In the pelvis it supplies the pyriformis and coccygeus muscles.

Pudic artery in the pelvis.

5. The *pudic artery* supplies the perinæum and the genital organs, and has nearly the same connections in the pelvis as the sciatic, from which it often springs. If the artery arises by a separate trunk from the internal iliac, it accompanies the sciatic, though external to it, and leaves the pelvis between the pyriformis and coccygeus. At the back of the pelvis it winds over the ischial spine of the hip bone, and enters the perinæum. (See p. 458.)

Some small offsets.

In the pelvic part of its course the artery gives some unimportant branches, and frequently the middle hæmorrhoidal branch arises from it.

When smaller than usual, an acces-

Peculiarities.—The pudic artery is sometimes smaller than usual, and fails to supply some of its ordinary perinæal branches, especially the terminal for the penis. In those cases the deficient

branches are derived from an artery, *accessory pudic* (Quain), which takes origin mostly from the trunk of the pudic inside the pelvis, and courses forwards on the side of the bladder, and the upper part of the prostate gland, to leave the pelvis below the pubic arch. It furnishes branches to supply the place of those that are wanting. sory branch comes from internal iliac.

The branches of the internal iliac artery that are peculiar to the female are two, the uterine and vaginal. Branches in the female.

6. The *uterine artery* passes inwards between the layers of the broad ligament, to the neck of the uterus. At that part the vessel changes its direction, and ascends along the side of the uterus to the fundus, where it anastomoses with the ovarian artery (spermatic) of the aorta. Numerous branches enter the substance of the uterus, ramifying in it, and anastomose with those of the opposite side. This artery and its branches are remarkable for their tortuous condition. Uterine artery supplies uterus.

a. At the neck of the uterus some small twigs are supplied to the vagina and the bladder; and the special vaginal artery may arise from it at that spot. Offsets to vagina,

b. Branches in the broad ligament. — One branch accompanies the round ligament into the inguinal canal and anastomoses with a branch of the epigastric. Another extends on the Fallopian tube, and divides into long branches that reach the end. And a third offset, according to J. Weber, is distributed to the ovary. and the broad ligament.

7. The *vaginal artery* seldom arises separately from the internal iliac: combined with the preceding, or with the branch to the rectum, this artery extends to the vagina, and ramifies in its wall as low as the outer orifice. Vaginal artery.

Other arteries in the pelvis. — The remaining arteries in the pelvis, which are not derived from the internal iliac, are the ovarian, superior hæmorrhoidal, and middle sacral. Branches of the aorta.

The *ovarian artery* has been described in part with the branches of the aorta, and has been traced to the pelvis (p. 573.). After passing the brim of the pelvis it becomes tortuous, and enters the broad ligament to be distributed to the ovary: in the ligament there is a free anastomosis between the ovarian and uterine arteries. Ovarian artery.

The *superior hæmorrhoidal artery* is the continuation of the trunk of the inferior mesenteric behind the rectum, and divides into two branches near the middle of the sacrum. Superior hæmorrhoidal.

From the point of the division of the trunk these branches are continued along the rectum, one on each side, and finally end in about six branches, which enter the gut three inches from the end, and terminate in anastomotic loops opposite the inner sphincter: they anastomose with the other vessels, viz. the middle and inferior hæmorrhoidal arteries.

Middle sacral, which

The *middle sacral artery*, a small branch from the bifurcation of the aorta, descends along the middle line of the body, over the last lumbar vertebra, the sacrum, and the coccyx, and terminates at the lower part of the spinal column, by anastomosing with the lateral sacral arteries.

has lateral offsets.

In its course the artery gives small branches laterally, opposite each piece of the sacrum, to anastomose with the lateral sacral arteries, and supply the nerves, and the bones with their periosteum. Sometimes a small branch is furnished by it to the lower end of the rectum, which takes the place of the middle hæmorrhoidal artery.

Internal iliac vein: veins uniting in it; position to its artery.

The INTERNAL ILIAC VEIN receives the blood from the wall of the pelvis, and the pelvic viscera, by branches corresponding for the most part with those of the arteries. The vein is a short and thick trunk, which is situate at first on the inner side of the internal iliac artery; but as it ascends to join with the external iliac it passes behind, and on the right side reaches even the outer aspect of its companion artery.

Its branches that are peculiar are

Some of the *branches* that form the trunk of the internal iliac vein, viz. the gluteal, obturator, and sciatic, have the same anatomy as the arteries; but the following visceral branches, the pudic and dorsal of the penis, the vesical and hæmorrhoidal, the uterine and vaginal, have some peculiarities.

pudic vein,

The *pudic vein* receives roots corresponding with the branches of the artery in the perinæum, but not those corresponding with the offsets of the artery on the dorsum of the penis. Its hæmorrhoidal branch commences in a large plexus around the lower end of the rectum (plexus hæmorrhoidalis) with which the superior hæmorrhoidal vein communicates.

dorsal vein of penis,

The *dorsal vein* of the penis receives vessels from the body of the penis, viz. the corpora cavernosa and corpus spongiosum, pierces the triangular ligament of the urethra,

and divides into two, a right and a left branch, which enter a plexus around the membranous part of the urethra and the prostate.

The *vesical veins* commence in a plexus about the lower part of the bladder, and anastomose with the prostatic and hæmorrhoidal veins. vesical,

The *uterine veins* are numerous, and form a plexus in and by the side of the uterus. This plexus inosculates above with the ovarian plexus, and below with one on the vagina. uterine, and

The *vaginal veins* surround the vagina with a large vascular plexus. vaginal veins.

Parietal veins of the pelvis. — The other veins of the wall of the pelvis, viz. the ilio-lumbar, lateral sacral, and middle sacral, open into the common iliac vein. Parietal veins.

Dissection.— To dissect the nerves of the pelvis it will be necessary to detach the urethra from the arch of the pubes, and to cut through on the right side the recto-vesical fascia and the levator ani, together with the visceral arteries, in order that the viscera may be drawn from the side of the pelvis. If the bladder is distended let the air escape from it. Dissection of the nerves of the pelvis,

By means of this dissection the sacral nerves will be seen as they issue from the sacral foramina; and the dissector should follow the first four into the sacral plexus, as well as some branches from the fourth to the viscera. A branch of nerve, superior gluteal, is to be shown arising from the lumbo-sacral cord, as this passes to the sacral plexus. The last sacral and the coccygeal nerve are of small size, and will be found coming through the coccygeus muscle close to the coccyx; these are to be dissected with care, and the student will best find them by tracing the connecting filaments which pass from one to another, beginning above with the offset from the fourth nerve. sacral and coccygeal,

Opposite the lower part of the rectum, bladder, and vagina is a large plexus of the sympathetic, the pelvic plexus, which sends offsets to the viscera along the arteries. This plexus is generally destroyed in this stage of the dissection; but if it should remain the student may trace the offsets from it, and the communicating branches with the spinal nerves. and sympathetic.

Spinal sacral nerves.— The anterior primary branches of the sacral nerves are five in number, and decrease suddenly in size from above downwards; for whilst the first two Sacral nerves are five;

are large trunks, the last two are small and slender. Issuing by the apertures in the front of the sacrum (the fifth nerve excepted), the nerves receive short filaments of communication from the gangliated cord of the sympathetic. The first three nerves, and part of the fourth, enter the sacral plexus, but the fifth ends on the back of the coccyx.

those that are peculiar are

The peculiarities of the fourth and fifth sacral, and the coccygeal nerve, may be noticed before the plexus formed by the other nerves is learnt.

fourth,

The *fourth nerve* divides into two parts, as above stated: one communicates with the sacral plexus; the other distributes the following branches to the viscera and the surrounding muscles, and joins the fifth nerve.

which gives

visceral

a. The *visceral branches* supply chiefly the bladder and the vagina, and communicate with the sympathetic nerve to form the pelvic plexus. Sometimes these branches come from the third sacral nerve.

and muscular offsets;

b. The *muscular branches* are three in number. One rather long branch enters the levator ani on its visceral aspect; another supplies the coccygeus; and the third reaches the perinæum by piercing the coccygeus muscle. (See page 448.)

fifth is below apertures in sacrum,

The *fifth nerve* comes forwards from the lower end of the spinal canal through the coccygeus muscle. As soon as it appears in the pelvis it receives the communicating branch from the fourth nerve; it is then directed downwards in front of the coccygeus, where it is joined by the coccygeal nerve, and perforates that muscle near the tip of the coccyx, to end on the posterior surface of the bone.

ends on coccyx.

Coccygeal nerve.

The *coccygeal nerve* (sixth sacral), after leaving the lower end of the spinal canal, appears through the coccygeus muscle, and joins the fifth sacral nerve in the manner above stated.

Sacral plexus;

situation

and form.

SACRAL PLEXUS. — This plexus is a large flat band, in which are united the lumbo-sacral cord, the first three sacral nerves, and part of the fourth sacral nerve. It is situate on the pyriformis muscle, and beneath the sciatic and pudic branches of the internal iliac artery. From the spot where the nerves join, the plexus becomes gradually smaller towards the lower end; and, leaving the pelvis below the pyriformis, terminates in branches for the lower limb.

Its branches to muscles inside the pelvis;

Most of the *branches* of the plexus arise outside the pelvis, and are distributed to the back of the lower limb. Only two internal muscles of the pelvis (pyriformis and obturator internus) receive their nerves from the sacral plexus.

one to obturator,

The *nerve of the obturator internus muscle* arises from the part of the plexus resulting from the union of the lumbo-sacral with the first sacral nerve; it leaves the pelvis with the pudic artery, and winds over the ischial spine of the hip bone and through the small sacro-sciatic notch to enter the perinæal surface of the muscle.

two to pyriformis.

The *nerves of the pyriformis* are commonly two in number, and arise from separate parts of the plexus: they enter the muscle at its visceral aspect.

Pudic nerve now seen at its origin.

The *pudic nerve*, like the artery of the same name, supplies the rectum, the perinæum, and the genital organs. The nerve arises at the lower part of the plexus as this is about to pass from the pelvis, and then accompanies its artery through the small sacro-sciatic notch to the perinæum. (See p. 459.)

Branches to the lower limb after.

The remaining branches of the plexus, viz. the small and great sciatic nerves, with small muscular offsets to the gemelli and quadratus femoris, are described with the lower limb.— See DISSECTION OF THE BUTTOCK.

Superior gluteal nerve ends in gluteal muscles.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord, and arises from it opposite the upper part of the large sacro-sciatic notch. It passes outwards above the pyriformis muscle to the back of the pelvis, where it ends chiefly in branches for the two smaller gluteal muscles.

Trace out the sympathetic.

Dissection.— Besides the large plexus of the sympathetic by the side of the bladder, the student will have to dissect the part of the gangliated cord that lies in front of the sacrum: its several ganglia (three or four), and their branches will come into view, on the removal of the connective tissue.

Sympathetic in the pelvis.

SYMPATHETIC NERVE. — In the pelvis the sympathetic nerve consists of a gangliated cord on each side, and of two lateral plexuses for the supply of the viscera.

The gangliated cord joins one of opposite side

The *gangliated cord* lies on the front of the sacrum and internal to the series of apertures in that bone. It is continuous superiorly with the lumbar part of the cord by a single or double internodal piece; whilst inferiorly the cords of opposite sides converge, and are united in front of the

below, where there is a ganglion. coccyx by means of a loop, on which is situate a single median ganglion (*gang. impar*). Each cord is marked by ganglia at intervals, the number varying from three to five.

Offsets of the ganglia From the ganglia branches of communication pass to the spinal nerves, and some filaments are directed inwards in front of the sacrum.

to the spinal nerves; The *connecting branches* are two to each ganglion, gray and white, and are very short; but, like those of the lumbar ganglia, they may enter two sacral nerves instead of one. The gray connecting cord unites the ganglion and the spinal nerve, but the white one is continued over the ganglion to the plexuses for the viscera.*

to the hypogastric plexus and the viscera. The *internal branches* are smaller than those of other parts of the cord, and communicate in front of the sacrum, and around the middle sacral artery, with branches from the opposite side. From the first, or first two ganglia, some filaments are furnished to the hypogastric plexus; and from the terminal connecting branches and the ganglion impar, in front of the coccyx, offsets descend over that bone.

Plexuses of the sympathetic: The *visceral* or *pelvic plexuses* (lateral inferior hypogastric) are two in number, a right and a left, and are continuous with the lateral prolongations of the hypogastric

situation; plexus (p. 518.). Each is situate by the side of the bladder and the rectum, or the side of the vagina in the female, and

how formed. is united with offsets from the third and fourth sacral nerves, to constitute the above-named plexus. Numerous ganglia are found in the plexus, especially at the points of union of the spinal and sympathetic nerves.

Offsets to the viscera of the male, viz.— From each plexus *offsets* are furnished to the viscera of the pelvis, and to the genital organs, along the branches of the internal iliac artery. These different secondary plexuses have the same name as the vessels on which they are placed; but as they may not be seen in the dissection, a mere enumeration of them will be sufficient.

to the rectum; The *inferior hæmorrhoidal plexus* is an offset to the rectum from the back of the plexus, and joins the sympathetic on the superior hæmorrhoidal artery.

to the bladder; The *vesical plexus* contains large offsets, with many white fibred or spinal nerves, and passes forwards to the side, and the lower

* See a Paper on the "Nerves of the Uterus," by Dr. T. S. Beck, in the *Philosophical Transactions* for 1846.

part of the bladder. It gives one plexus to the vesicula seminalis, and another to the vas deferens.

The *prostatic plexus* leaves the lower part of the pelvic plexus and is distributed to the substance of the prostate gland. At the front of the prostate an offset (cavernous) is continued onwards to the dorsum of the penis, to supply the cavernous structure. On the penis the cavernous nerves join the pudic nerve. to the prostate gland and the penis.

In the female there are the following additional plexuses, for the supply of the viscera peculiar to that sex: — Offsets in the female:

Ovarian plexus. — The principal nerves to the ovary are derived from the renal and aortic plexuses, and accompany the artery to that body; but the uterine nerves supply also some filaments to it. to the ovary;

Vaginal plexus. — The nerves to the vagina are of large size, and are not plexiform, but consist in greater part of spinal nerve fibres; they end in the lower part of the tube. to the vagina;

The *uterine nerves* are furnished to the uterus without direct admixture with the spinal nerves. The nerves ascend along the side of the uterus, and are, for the most part, long slender filaments, without ganglia or communications as far as their termination in the substance of the viscus. The Fallopian tube receives its branches from the uterine nerves. and to the uterus: no ganglia.

Some few nerves that surround the arteries of the uterus are plexiform and ganglionic. — Beck. Nerves on vessels ganglionic.

The *lymphatic glands* of the pelvis form a chain in front of the sacrum, and along the internal iliac artery. The efferent ducts of these bodies join the lumbar glands. Into these glands the deep lymphatics of the penis, those of the genital organs in the female, and the lymphatics of the viscera and the wall of the pelvis are collected. Chain of glands in pelvis; lymphatics entering them.

Section V.

ANATOMY OF THE VISCERA OF THE MALE.

Directions. — The bladder and the parts at its base, viz. the vesiculæ seminales and the prostate gland, are to be taken first for examination.*

Dissection. — To study the form and structure of the viscera, it will be necessary to remove them from the cavity of the pelvis. For this purpose the student should carry the scalpel around the pelvic outlet, close to the osseous Take out the viscera.

* The anatomy of the viscera of the female is contained in Section VI. p. 631.

boundaries, so as to detach the crura of the penis from the bones, and to divide the parts connected with the end of the rectum.

Clean the bladder and prostate. When the viscera are removed, the rectum is to be separated from the other organs; but the bladder, the penis, and the urethra are to remain united. After the bladder has been distended with air, the peritoneum and the connective tissue are to be dissected from the muscular fibres. The prostate gland and the vesiculæ seminales are to be then cleaned; and the duct of the latter, with the vas deferens, is to be followed into the gland. If any of the integument has been left on the penis and the urethra it is to be taken away.

THE PROSTATE GLAND AND SEMINAL VESICLES.

Prostate gland: use and situation. PROSTATE GLAND.— This is a firm muscular and glandular body which secretes a special fluid, and surrounds the neck of the bladder and the beginning of the urethra. Its connections with the surrounding parts have been enumerated (p. 598.).

Form, This body is conical in form, with the base or larger end directed backwards, and is usually likened to a chesnut, dimensions, which it much resembles. Its dimensions in different directions are the following:— Transversely at the base it measures about an inch and a half; from apex to base rather more than an inch; and in depth about three quarters of an inch or an inch: so that an incision directed obliquely downwards and outwards from the apex to the base, at its lateral part, will be the longest that can be practised in the and weight. half of this body. Its weight is about an ounce, but in this respect it varies greatly.

Surfaces; The upper surface of the prostate is rounded, but a slight groove lies along the middle; and the under surface, which is larger and flatter, is marked by a median hollow that and base. indicates the division into lateral lobes. The posterior part, or the base, is thick, and in its centre is an excavation which receives the common ejaculatory ducts.

Three lobes; Three lobes are described in the prostate, viz. a middle and two lateral, though there is no fissure in the firm mass. The *lateral* parts or lobes are similar on each side, and

are separated only by the hollow on the under surface; they form the chief part of the prostate, and are prolonged back, on each side, beyond the notch in the base. The *middle* lobe will be brought into view by detaching the vesiculæ seminales and the ejaculatory ducts from the bladder: it is a small piece of the gland between the neck of the bladder and the ejaculatory ducts, which extends transversely between the lateral lobes. Oftentimes this middle lobe is enlarged in old people, and projects upwards into the bladder, so as to interfere with the flow of the urine from that viscus, or the passage of a catheter into it. two lateral and a central.

The urethra and the two common ejaculatory ducts are contained in the substance of the prostate: the former is transmitted through the gland from base to apex; and the latter perforate it obliquely to terminate in the urethral canal. Gland contains three tubes.

Structure. — On a section the gland appears reddish in colour, is very firm to the feel, and is scarcely lacerable. It is made up of a mass of fibrous and involuntary muscular tissue with interspersed glandular structure; and the whole is enveloped by a fibrous coat. Structure.

Fibrous covering.— This forms a thin investment for the gland, and sends offsets into the interior. It is quite distinct from the dense capsule derived from the pelvic fascia, and is separated from that by the plexus of veins. Fibrous case distinct from pelvic fascia;

Muscular tissue. — The firm fibrous looking part of the gland consists of involuntary muscular fibres, intermixed with elastic and connective tissues. The muscular fibres are arranged circularly around the tube of the urethra: they are continuous behind with the annular fibres of the bladder, and in front with a layer of circular fibres around the membranous part of the urethra. At the lower and outer parts of the gland the texture is looser and more spongy, especially where the glands are situate and where the larger vessels enter.* This arrangement will be better seen afterwards when the urethra has been opened. Muscular and fibrous tissue; How arranged.

Glandular structure.— This element, forming but about one third of the whole gland, is in greatest abundance towards the circumference and in the part called middle lobe. The Glands only few;

* See a Paper by the Author in vol. xxxix. of the *Med. Chir. Trans.*, 1856.

ducts are branched as in other glands; and when they are traced into the interior from the urethra, the final radicles will be found to be surrounded by small sessile vesicles, which open into them. On the exterior of the vesicles and the ducts the bloodvessels ramify; and lining the interior of the tubes is an epithelium of the columnar kind, which becomes laminar in the vesicles. The ducts of the gland are not collected into one excretory tube, but vary in number from twelve to twenty, and open into the prostatic part of the urethra (p. 625.)

nature and ending; on ducts are vessels. Ducts open into urethra.

Arteries. *Bloodvessels.* — The *arteries* are unimportant, and are furnished by the vesical and hæmorrhoidal (p. 609.). The *veins* form a plexus around the gland, which communicates in front with the dorsal vein of the penis, and behind with a plexus of veins at the base of the bladder. In old men this vascular communication gives rise to considerable hæmorrhage in the operation of lithotomy.

Veins form a plexus.

Seminal vesicles. Definition. Situation. Sacculated.

VESICULÆ SEMINALES. — These vesicles are two membranous sacs, that are supposed to serve as reservoirs for the secreted semen. They are placed on the under part of the bladder behind the prostate, and diverge from one another so as to limit laterally a triangular surface at this aspect of the viscus: their form and connections have been already described (p. 599.). Though sacculated behind, the vesicula becomes straight and somewhat narrowed in front; and at the base of the prostate it is blended with the vas deferens to form the common ejaculatory duct.

Formed of a coiled tube. Length.

The vesicula seminalis consists, like the epididymis, of a tube bent into a zigzag form, so as to produce lateral sacs or pouches, which are bound together by fibrous tissue; this cellular structure will be shown by means of a cut into it. When the bends of the vesicle are undone, its formative tube, which is about the size of a quill, measures from four to six inches, and ends posteriorly in a closed extremity: connected with the tube, at intervals, are some lateral cæcal appendages.

End of vas deferens.

End of vas deferens. — Opposite the vesicula the vas deferens is increased in capacity, and is rather sacculated like the contiguous vesicle; but before it joins with the tube of that body to form the common ejaculatory duct, it diminishes in size, and becomes straight.

Vesicle has a

Structure. — The seminal vesicle has the same number of

coats, and the same in kind as the vas deferens (p. 567.). Within the casing of the recto-vesical fascia, the vesiculæ and vasa deferentia are covered by a muscular layer of transverse and longitudinal involuntary fibres. The transverse are the more superficial (the base of the bladder being upwards), are strongest near the prostate, and act most on the vasa deferentia. The longitudinal fibres, placed chiefly on the sides of the vesiculæ, are continued forwards with the common seminal ducts to the urethra. The *mucous membrane* is thrown into ridges by the bending of the tube, and presents an areolar or honeycomb appearance: it is lined by a laminar epithelium. In the sacculated part of the vas deferens the mucous lining resembles in a slight degree that in the vesicula.

special coat; a covering of muscular fibres; and a mucous coat.

Common seminal ducts.—These tubes (right and left) are formed by the junction of the duct of the vesicula seminalis with the vas deferens of the same side, and convey the semen to the urethra. They begin opposite the base of the prostate, and are directed upwards and forwards through an aperture in the circular prostatic fibres, and along the sides of a hollow (vesicula prostatica), to open into the urethral tube. Their length is rather less than an inch, and their course is convergent to their termination, where they are close together in the floor of the urethra (p. 625.).

Seminal ducts: how formed. Extent, course, length, and termination.

Structure.—The wall of the common duct is thinner than that of the vas deferens, but it possesses similar coats. It is surrounded by longitudinal involuntary muscular fibres, which blend with the submucous stratum of the urethra.

Structure.

THE BLADDER.

After the bladder has been separated from the surrounding parts, its form, and the extent of its different regions can be more conveniently observed.

Bladder out of the body.

Whilst the bladder is in the body, it is conical in shape, and rather flattened from before backwards; but it is now more circular than when in its natural position, and has lost that arched form by which it adapts itself in distension to the curve of the pelvis. If this viscus is moderately dilated, it measures about five inches in length, and about three inches across.—Hüschke. Its capacity is greatly influenced

Form. Dimensions.

by the age and sex, and by the habits of the person. Ordinarily the bladder holds about a pint, and as a general rule it is larger in the female than in the male.

Coats of the bladder. STRUCTURE. — A muscular and a mucous coat, with an intervening fibrous layer, exist in the wall of the bladder: at parts the peritoneum may be also enumerated as a constituent of the wall. The vessels and nerves are large.

Peritoneal. The imperfect covering of *peritoneum* has been described (p. 594.), and has been removed.

Muscular has three strata; The *muscular* coat is formed of thin strata of unstriated muscular fibres, viz. an external or longitudinal, a middle or circular, and an internal or submucous.

external or longitudinal, *a.* The *longitudinal* fibres form a continuous covering, with the usual plexiform disposition of the bundles of muscular fibres, and extend from the apex to the base: above some are connected with the urachus, and others are inserted into the peritoneum; and below they are attached chiefly to the fascia covering the prostate, with the exception of an anterior fasciculus on each side, which is united to the back (attachments) of the pubes, through the anterior true ligament of the bladder. On the front and back of the bladder the muscular layer is stronger, and its fibres more vertical, than on the lateral parts. Sometimes this outer layer of fibres has (forms detrusor urinæ;) been called *detrusor urinæ*, from its action in the expulsion of the urine.

internal or circular gives rise to sphincter; continuous with prostate; *b.* The *circular* fibres are thin, and scattered on the body of the bladder; but around the cervix they are collected into a thick bundle, called the *sphincter vesicæ*, and are then continuous with the fibres of the prostate. In some instances the fibres are hypertrophied, and project into the interior of the organ, forming the fasciculated bladder; and in other bodies the mucous coat may be forced outwards here and there, between the fibres, in the form of sacs, producing the sacculated bladder.

submucous layer. *c.* The *submucous* stratum forms a continuous layer over the lower half of the bladder, but becomes scattered above. Extent. In the lower third of the bladder the fibres are longitudinal, Fibres. and continuous with the fibres around the urethra, but they Addition to it. become oblique above that point. At the back of the bladder the layer is increased in strength by the longitudinal fibres

of the ureters blending with it. The projection of the uvula vesicæ is due to this submucous stratum.

The different muscular strata communicate freely, so that one cannot be separated from another without division of the connecting bundles of fibres. In both sexes the disposition of the muscular fibres is similar.* Strata are joined. Bladder alike in both sexes.

Fibrous coat.—This stratum is placed between the muscular and mucous layers, and is enumerated amongst the coats of the bladder; it is composed of areolar and elastic tissues as in other hollow viscera, and in it the bloodvessels ramify. Fibrous coat.

Dissection.—The bladder is now to be opened by an incision down the front; and the same cut is to be continued along the upper part of the prostate gland. Open the bladder.

The *mucous membrane* of the bladder is continuous posteriorly with that lining the ureters, and anteriorly with that of the urethra. It is very slightly united to the muscular layer in consequence of the intervention of the submucous stratum, and is thrown into numerous folds, in the flaccid state of the viscus, except over a small triangular surface behind the opening into the urethra. The membrane is soft and smooth to the feel, and of a pale rose colour in the healthy state. Its surface is studded with small mucous follicles, particularly towards the neck of the bladder. A *spheroidal* epithelium covers the surface. Mucous coat has folds except on one spot. Follicles. Epithelium.

Interior of the bladder.—Within the bladder the following parts are to be remarked, viz., the orifices of the ureters and urethra, with the triangular space. Interior of the bladder.

Orifices.—At the lower and anterior part of the bladder is the orifice of the urethra, surrounded by the prostate gland. The mucous membrane presents here some longitudinal folds, and the aperture is partly closed by a small prominence below, *uvula vesicæ*, occasioned by a thickening of the submucous muscular layer. This eminence is placed in front of the middle lobe of the prostate, and from its anterior part a slight ridge is continued on the floor of the urethra. Opening of urethra, with its uvula.

About an inch and a half behind the orifice of the urethra, and rather more than that distance apart, are the two narrow Openings of

* See a Paper before referred to in the *Trans. of the Med. Chir. Society*, 1856.

the ureters.

openings of the ureters. These excretory tubes for the urine perforate the wall of the bladder obliquely, lying in it for the distance of half an inch, and therefore the reflux of fluid through them towards the kidney is prevented as the bladder is distended: they terminate on each side by a contracted slit-like opening in the centre of a prominence.

Trigone of the bladder; how bounded; part corresponding externally.

Triangular surface. — Immediately behind the orifice of the urethra is a smooth triangularly-shaped part of the bladder, which is named *trigone* (trigonum vesicæ). Its apex reaches the prostate, and its base the ureters; or its boundaries may be marked out by a line on each side from the urethra to the ureter, and by a transverse one behind between the ureters. This space corresponds with the interval at the base of the bladder, between the prostate in front and the vesiculæ and vasa deferentia on the sides; and over it the mucous coat is closely united to the fibrous and muscular, so as to prevent the accidental folds found in the other parts of the empty bladder.

To expose muscles of ureters.

Dissection. — The ending of the ureters will come into view on the removal of the mucous membrane from the lower third of the bladder: the fibres are best marked in a muscular bladder.

Muscular fibres of ureters.

Ending of the ureters. — As soon as the ureter pierces the outer and middle coats of the bladder, its longitudinal fibres are thus disposed: — the more internal and strongest are directed transversely, and join with the corresponding fibres of the other urine tube, whilst the remainder are directed down over the triangular space and join the submucous layer.*

Arteries; veins; nerves.

Bloodvessels and nerves. — The source of the vesical *arteries*, and the termination of the *veins* are before detailed (p. 609. 613.). In the bladder the vessels are disposed in greatest number about its base and neck. Most of the *nerves* that are distributed to the bladder, though supplied from the pelvic plexus of the sympathetic (p. 616.), are derived directly from the spinal nerves.

* *Trans. of Med. Chir. Society*, 1856. Sir C. Bell described these fibres as distinct muscles for the purpose of acting on the opening of the ureter. See the *Med. Chir. Transactions*, vol. iii.: "Account of the Muscles of the Ureters."

THE URETHRA AND PENIS.

URETHRA.— The tube of the urethra extends from the neck of the bladder to the end of the penis, and has an average length of about eight inches. In that extent the canal is supported by the prostate, by the spongy structure of the penis, and by muscular fibre, so that it does not require so thick a continuous muscular coat as in many other excretory tubes. The size of the urethra varies at different spots, and the tube is divided, as before said (p. 599.), into a prostatic, a membranous, and a spongy part.

Urethra: extent and length; no special coat. Division into parts.

Dissection.— To open the urethra, let the incision through the upper part of the prostate be continued onwards to the extremity of the penis, so as to divide the corpus cavernosum of that body rather on one side of the middle line, and to leave uncut the septum in it.

How to open the urethra.

The *prostatic* part is nearer the upper than the lower aspect of the gland that surrounds it, and lies at first above the middle lobe of the prostate. It is about one inch and a quarter in length, and is altogether the widest and most extensible division of the urethral canal. The form of this part of the tube is spindle-shaped, for it is larger in the middle than at either end. Its transverse measurement, at the neck of the bladder, is about a quarter of an inch; at its centre a line or two more; and at the front rather less than at the back.

Prostatic part. Dimensions and shape; diameter.

On the floor of the passage, at the neck of the bladder, is the eminence of the uvula vesicæ. In front of this is a central longitudinal ridge of the mucous lining, about three quarters of an inch in length and larger behind than before, which is prolonged anteriorly towards the membranous part of the canal, and is named *crest* of the urethra (veru montanum, caput gallinaginis); it is formed like the uvula, by a bundle of the submucous muscular fibres. In the central fold or crest of the mucous membrane, near its posterior extremity, is a slight hollow named *vesicula prostatica* or *sinus pocularis.*

On the floor is a crest. In the crest is a pouch.

The depression in the mucous fold, or the *vesicula prostatica*, is a cæcal appendage to the urethral canal, and is directed backwards and downwards in the substance of

Vesicula projects into the prostate,

the prostate, for the distance of a quarter of an inch or less, passing beneath the middle and between the lateral lobes; its orifice in the urethra is about a line wide, and its closed extremity is dilated. In its wall, on each side, is contained the common ejaculatory duct, which opens by a narrow slit on or within the free margin of the mouth of the sac. Small glands open likewise on the surface of the mucous membrane lining it. Some bristles should be introduced into the ejaculatory ducts, to render evident their position and apertures.

And in it are the ejaculatory ducts.

Prostatic sinuses also in floor.

On each side of the central ridge or crest is an excavation which is named the *prostatic sinus.* Into this hollow the greater number of the ducts of the prostate open; whilst the apertures of others are seen at the posterior part of the central ridge, behind the hollow in it.

Membranous part.

The *membranous part* of the urethra is nearly an inch in length, and intervenes between the apex of the prostate gland and the bulb of the corpus spongiosum urethræ. In its interior are slight longitudinal folds. This is the narrowest portion of the whole canal, with the exception of the orifice, and measures rather less than a quarter of an inch across. It is the weakest of the three divisions of the canal, and is supported by a thin stratum of erectile tissue, by a thin layer of involuntary circular fibres (p. 457.), and outside all by the compressor urethræ muscle.

Dimensions.

Parts around.

Spongy part.

The *spongy part* includes the rest of the urethra, viz. to the end of the penis. It is about five inches in length, and its strength depends upon an enveloping material, named corpus spongiosum urethræ. The average size of the canal is about a quarter of an inch in diameter, though at the vertical slit (meatus urinarius), by which it terminates on the glans penis, the tube is smaller than at any other part of the urethra. Two dilatations exist in the floor of the spongy portion: — one is contained in the bulb or bulbous part of the urethra, and is named *sinus* of the bulb; the other is situate in the glans penis, and has been called *fossa navicularis* from its shape. Many small pouches or *lacunæ* are seen in the interior of the canal, chiefly along the floor, as far back as the membranous part, and have their apertures turned towards the outer orifice of the urethra. One of these is larger than the rest, *lacuna magna,* and is placed

Dimensions.

Two dilatations: one in bulb, one in glans.

Lacunæ.

One larger than the rest.

generally on the upper aspect or the roof of the urethra, opposite the fossa navicularis. The ducts of Cowper's glands open on the mucous membrane: they are two in number, and terminate, one on each side, on the floor of the urethra near the front of the bulb, but in the ordinary examination they are seldom to be recognised. Ducts of glands of Cowper.

Mucous lining of the urethra. — The mucous membrane of the urethra is continued into the bladder, as well as into the ducts opening into the canal, and joins in front the tegumentary covering of the glans penis. It is of a reddish colour in the spongy and membranous portions, but in the prostate it becomes whiter. In the spongy and membranous parts it is thrown into longitudinal folds during the contracted state of the penis. Its surface is studded with follicles, and with the apertures of mucous glands; and is provided with papillæ towards the external orifice. Its *epithelial* covering is of the columnar kind, but near the meatus externus this becomes laminar. Mucous membrane: extent; colour; folds; glands; epithelium.

Submucous tissue. — Beneath the mucous lining of the urethra is a stratum of longitudinal involuntary muscular fibres mixed with elastic and fibrous tissues. It is continuous behind with the submucous fibres of the bladder, and is joined in the prostate by the fibres accompanying the common seminal ducts. This structure differs in quantity along the canal. It is most developed in the prostate, where it forms the projection of the crest and blends with the circular fibres of that body. In the membranous portion of the canal the muscular structure is less abundant. In the spongy part the submucous structure is richer in fibrous elements; and the muscular fibres end in the usual way in the submucous tissue towards the outer orifice.* Submucous tissue; nature; arrangement in prostate, in membranous, and in spongy parts.

In the prostatic and membranous divisions of the urethra there is, in addition, a thin enveloping layer of vascular or erectile tissue, which is continued backwards from the corpus spongiosum urethræ to the neck of the bladder. Erectile tissue throughout.

Structure of the Penis. — The form and the connections of the penis having been described at page 600., it remains now to notice the tissues of which it is composed. The section already made through the penis shows this body Penis formed of two vascular erectile bodies.

* For farther detail refer to the Paper before mentioned.

to be made up of two masses of spongy and vascular tissue incased in fibrous coverings — one constituting the corpora cavernosa, the other the corpus spongiosum urethræ.

Cavernous material; the structures of which it consists.

Corpora cavernosa. — Each corpus cavernosum is constructed of a firm tunic, which encloses a cavernous or trabecular structure, and contains a plexus of vessels in the intervals of the spongy mass. An incomplete median septum exists along the body of the penis between the corpora cavernosa.

A case that sends in processes.

The fibrous case of the corpus cavernosum is a white, strong, elastic covering, from half a line to a line in thickness. Along the middle line of the penis a septal process is sent inwards from it; and numerous other finer bands or trabeculæ of the spongy structure are connected with its inner surface. It is formed of white shining fibres that are disposed in two layers, outer and inner. The outer stratum is formed of longitudinal fibres arranged as involuntary muscular tissue, with close meshes. The inner stratum consists of circular fibres, with a like plexiform arrangement; and the circular fibres of each cavernous body meeting in the middle line give rise to the septum penis.* Both strata are inseparably united by communicating bundles, as in the intestine.

Fibres form strata: inner forms septum.

One septal piece, which is imperfect; how formed;

The septal process extends along the body of the penis, and is thicker and more perfect behind than in front. At the point of junction of the crura of the penis, this partition separates the enclosed cavity of the organ into two parts; but as it reaches forwards it becomes less strong, and is pierced by elongated apertures, which give it the appearance of a comb, whence the name *septum pectiniforme*. Through the intervals in the septum the vascular tissue of one corpus cavernosum communicates with that of the other. It is formed, as above said, by the circular fibres of the cavernous bodies.

and numerous bands and cords to form a network.

The cavernous or trabecular structure is a network of fine cords, which fills the interior of the corpora cavernosa. The processes are thinner towards the centre than at the circumference of the fibrous case; and the areolar spaces are larger in the centre and at the fore part of the contained

* Paper in the *Med. Chir. Transact.*

cavity, than at the circumference or in the crura of the penis. In addition to white fibrous tissue, the trabeculæ contain elastic fibres and involuntary muscular fibres.— Müller. The cellular structure of the penis may be demonstrated by sections of that body after it has been distended with air and dried.

In the cords some muscular fibres.

Bloodvessels. — The bloodvessels of the penis are large in size, and serve to nourish as well as minister to the function of the organ. Having entered the cavernous mass, they ramify in the interstices of the trabecular structure, and end in the venous plexuses.

Vessels are erectile;

The *arteries* of the corpora cavernosa are offsets of the pudic, both at the root and along the body of the penis. Entering the cavernous structure, they divide into branches, which ramify in the trabeculæ, becoming finer and finer, until they cease in one of the two following ways: — The greater number of the vessels terminate in capillaries, as in other parts; but Valentin states that some of the smallest arterial branches open by large orifices into the veins in the intertrabecular spaces, without the intervention of capillaries. Others of the terminal twigs end in tufts of short, slightly curled vessels — the *helicine* arteries of Müller, which project into the intertrabecular spaces, and are imbedded in the coat of the thin veins: these twisted vascular bodies have dilated cæcal parts; they then become finer and end in the venous spaces (Kölliker). The helicine arteries exist in greatest number at the posterior part of each corpus cavernosum.

Source of the arteries.: termination in capillaries. in dilated veins, or in the helicine arteries.

The *veins* fill the interspaces of the areolar structure, and anastomose freely together to form venous plexuses. In these spaces the walls of the veins are very thin, because they receive support from the surrounding fibrous structure. Into the large radicles of the veins the capillaries pour their contents; and the erectile condition of the corpus cavernosum is produced by the distension of those receptacles. By means of the apertures in the septum, the veins of opposite sides communicate freely.

Veins are dilated and form plexuses.

Most of the veins of the corpus cavernosum issue along the upper and under aspects of the penis, to end in the dorsal vein; but some escape near the roots of the body, and join the pudic vein and the prostatic plexus.

Ending of the veins.

Spongy material of the penis; *Corpus spongiosum urethræ.*— This constituent part of the penis surrounds the urethra, and forms behind the bulb and in front the glans penis (p. 601.). The urethra is not enveloped equally on all sides by this tissue, for, at the bulb, only a thin stratum is above the canal. Posteriorly an offset of the corpus spongiosum is continued beyond the bulb, around the urethra.

its structure like cavernous. *Structure.*— The tissue of the corpus spongiosum is similar to that of the corpus cavernosum: thus it consists of a fibrous tunic, enclosing a trabecular structure and a plexiform arrangement of the bloodvessels.

The fibrous case. Imperfect septum. The fibrous covering is less dense and strong than in the corpora cavernosa, and consists only of circular fibres. A piece projects inwards from it in the middle line, opposite the tube of the urethra: this is best marked for a short distance in front of the bulb, and assists in dividing that body into two lobes. The trabecular bands are much finer, and more uniform in size, than those of the corpora cavernosa.

Bloodvessels likewise erectile, and helicine. *Bloodvessels.*— The terminal arrangement of the bloodvessels in the erectile structure of the corpus spongiosum is almost identical with that in the corpora cavernosa; but the helicine terminations of the arteries are absent from the glans penis, where the veins form a very close and regular plexus.

Source of arteries. The *arteries* are derived from the pudic on each side; they are the artery of the bulb, and offsets from the dorsal artery, and enter the spongy structure — the first behind, and the latter in front at the glans where they most abound. Kobelt describes another branch to the bulb, at the upper aspect.

Termination of the veins. Most of the *veins*, including those of the glans, end in the large dorsal vein of the penis, and some communicate with those of the cavernous body; others issue from the bulb, and terminate in the pudic vein and the prostatic plexus.

Nerves. *Nerves and lymphatics.*— The *nerves* of the penis are large and are furnished by both the spinal and sympathetic nerves (p. 460—617.): on the bulb of the urethra and the glans penis, they end in Pacinian bodies.— Fick. Lymphatics. The superficial *lymphatics* join the inguinal glands; the deep accompany the veins beneath the arch of the pubes, to end in the glands in the pelvis.

THE RECTUM.

The lower end of the large intestine, which is contained in the pelvis, is not sacculated like the colon, but is smooth on the surface. Rectum is smooth.

Dissection. — The rectum is to be washed out, and then distended with air; and the peritoneum and the loose fat are to be removed from it. To prepare the gut.

The *rectum* is about eight inches in length, and its average diameter is that of the sigmoid flexure of the colon. Its size is uniform till towards the lower extremity, where it is dilated, particularly in old people, but at the aperture of termination in the anus the gut is smaller than in any other part of its extent. The longitudinal bands of the colon are absent from this portion of the alimentary canal, and the fibres are spread over the surface. Length; dimensions.

Structure. — The rectum, like the rest of the large intestine, contains in its wall a peritoneal, a muscular, a mucous, and a submucous stratum. In it the muscular and the mucous layers have certain peculiarities that serve to distinguish this from other parts of the intestinal tube. Same coats as in the rest of the intestine.

The *peritoneum* forms but an incomplete covering, and its arrangement is referred to in the description of the connections of the pelvic viscera (p. 594.). Peritoneum.

The *muscular* coat consists of two planes of fibres, as in the œsophagus, viz. a superficial or longitudinal, and a deep or circular: these fibres belong to the pale or unstriated kind. Muscular coat

The *longitudinal* fibres are continuous with those in the bands on the colon, but are here diffused to form a stratum around the gut. has longitudinal

The *circular* fibres describe arches around the intestine, and become thicker and stronger towards the lower extremity, where they are collected into the band of the internal sphincter muscle. and circular fibres.

The *mucous* coat is more moveable than that in the colon, and resembles in this respect the lining of the œsophagus; it is also thicker and more vascular than that of the rest of the large intestine. When the bowel is contracted the mucous lining is thrown into numerous accidental folds, Mucous coat thick and vascular. Folds in it:

some of which near the anus are longitudinal. But there are other three or four permanent folds, described by Mr. Houston, which are half an inch or less in width, and contain some of the circular fibres of the gut.* The most constant of these is about three inches from the anus, on the front of the rectum, opposite the base of the bladder; another is found on the right side of the intestine near the top; and the third is on the left side, midway between the other two: occasionally there is a fourth on the back of the rectum, about an inch from the anus. These folds will be seen by laying open the gut along the side, provided it is tolerably fresh.

some are permanent.

Structure; The mucous membrane has the same general structure as in the colon, but towards the anus the secretory apparatus gradually disappears.

Arteries. *Bloodvessels.*—The *arteries* are supplied from three different sources: they are, superior hæmorrhoidal, from the inferior mesenteric; middle hæmorrhoidal, from the internal iliac artery; and inferior hæmorrhoidal, from the internal pudic. All three sets anastomose on the lower end of the gut, and only the upper hæmorrhoidal, which is the largest, requires further notice. The branches of this artery (p. 516.) about six in number pierce the muscular coat three inches from the anus, and descend between the mucous and muscular coats as far as the internal sphincter, where they end in loops like the veins, which pass from branch to branch just within the anus, and form circular arterial rings. The *veins* are deficient in valves, and communicate freely around the lower end of the gut. Above, they join the inferior mesenteric vein, and, through it, reach the vena portæ; and, posteriorly, they pour some blood into the internal iliac vein by branches corresponding with the middle hæmorrhoidal artery.

arrangement of superior hæmorrhoidal.

Veins are without valves.

Nerves; *Nerves and lymphatics.*—The nerves for the intestine are obtained from the sympathetic, and those for the sphincter, from the spinal system. The lymphatics terminate in the chain of glands on the sacrum.

lymphatics.

Section VI.

ANATOMY OF THE VISCERA OF THE FEMALE.

Viscera in the pelvis. The viscera of the female pelvis consist of those common to both sexes, viz. the bladder and the urethra, with the

* Vol. v. of the *Dublin Hospital Reports*, "Observations on the Mucous Membrane of the Rectum."

rectum; and of those that are special to the female, viz. the organs of generation.

To remove the viscera,

Dissection.— The contents of the pelvis are to be removed together with the genital organs. In this proceeding, the student is to keep the scalpel close to the osseous boundary of the pelvic outlet, to avoid the end of the rectum, and the crura of the clitoris that are connected to the bone. After the parts referred to are taken from the body, the rectum is to be detached from the uterus and the vagina, but the rest of the viscera may remain united until the genital organs are examined. The bladder may be moderately distended, and the fatty tissue and the vessels are to be removed from the viscera.

and prepare them.

ORGANS OF GENERATION.

The generative organs of the female are classed into external and internal, from their position with respect to the pelvis.

External organs are

The external or genital organs consist of the following parts: — the mons Veneris and the external labia, the clitoris and the internal labia, and the vestibule with the meatus urinarius. Within the external labia is the aperture of the vagina, with the hymen or the remnant of it. Sometimes the term vulva or pudendum is applied to these parts as a whole.

mons Veneris and

Mons Veneris and labia pudendi.— In front of the pubes the integument is covered with hair, and is raised into a slight eminence,—*mons Veneris*, by a layer of subjacent fat. Extending downwards from the prominence mentioned, are two folds of integument, the *labia pudendi* (labia majora), which correspond with the scrotum in the male. Above and below, the labia are united, the points of junction being named commissures, but between them is an interval called *rima*. The labia decrease in thickness inferiorly; they are covered externally with a few hairs, but are lined internally with a mucous membrane provided with follicles and sebaceous glands. In them is a dartoid tissue resembling that in the male scrotum. Within the lower commissure of the labia is a small thin transverse fold of integuments named *fourchette*, or frænulum; and between this fold and the lower commissure is the interval of the *fossa navicularis*.

labia majora.

Fourchette and fossa.

Clitoris; *Clitoris and nymphæ.*—Beneath the upper commissure of the labia majora is the projection of the clitoris, with the nymphæ or smaller labia descending from it.

dissection to see it. *Dissection.*— To see the clitoris, the integument forming the upper commissure must be removed, and, after the body of the organ has been laid bare, the crura are to be followed outwards one to each side.

It is like the penis; The clitoris is a small erectile body, and is the representative of the penis; it has the same anatomy as that organ, with the exception that the urethra and the spongy enveloping substance are not continued below it. has a glans and prepuce, Its anterior extremity is terminated by a rounded part or *glans*, and is covered by a fold of the skin, corresponding to the prepuce of the male, which is provided with sebaceous glands. In its composition this organ resembles the penis in the following particulars:—it consists of corpora cavernosa, which corpora cavernosa, are attached by crura (one on each side) to the pubic arch, and are then blended to form one body with an imperfect pectiniform septum; and further, it possesses a corpus spongiosum, but this structure is limited to the glans clitoridis, which it forms.

and erectile tissue. *Structure.*— The outer casing and the septum are alike in both penis and clitoris; and in the interior of the clitoris is an erectile tissue, like that of the male (p. 629.).

Labia minora descend from prepuce. The *nymphæ* (labia minora) are two folds of mucous membrane that descend from the end of the clitoris, one on each side of the orifice of the vagina: they are continuous above with the preputial covering of the clitoris, and extend down about one inch and a half. The inner surface is continuous with the lining of the vestibular space and the vagina; and the outer, with the covering of the external labium. Bloodvessels are contained in each fold.

Vestibule. *Vestibule and orifice of the urethra.*—Within the nymphæ, between the clitoris above and the vagina below, is an angular interval, about one inch and a half deep, which is called the *vestibule*. Opening of the urethra. In the middle line of the vestibular space is the round orifice of the urethra, which is placed in an eminence about one inch below the clitoris, and near the aperture of the vagina.

Aperture of the vagina. *Orifice of the vagina and the hymen.*— The aperture of the vagina is close below the meatus urinarius, and varies

much in size. In the child and in the virgin it is partly closed below by a thin semilunar fold of mucous membrane named the *hymen*. After the destruction of the membrane small irregularly-shaped projections, *carunculæ myrtiformes*, exist around the opening of the vagina. Hymen and carunculæ.

The internal generative organs are the uterus and the vagina, and the ovaries with the Fallopian tubes.

Dissection.— The viscera are now to be separated, so that the bladder and the urethra may be together, and the vagina and the uterus remain united. The bladder is to be set aside for subsequent use, and the other organs may be first learnt. The surface of the vagina, and of the lower part of the uterus should be cleaned, but the peritoneal investment of the latter is to be left untouched for the present. Separate vagina and uterus.

THE VAGINA.

The vagina is a dilatable tube, which is connected with the uterus at one end, and terminates in the vulva at the other. It has a curved course between the two points mentioned: and the anterior and posterior surfaces of the tube are not equal in length, for whilst the former measures about four inches, the latter is about five or six in extent. Vagina: extent and curved course.

In its position in the body the vagina is flattened from above downwards, so that the opposite surfaces may be in contact, but the upper end is rounded where it is joined to the uterus. Its size varies at different spots: thus the external orifice which is surrounded by the constrictor vaginæ muscle is the narrowest part, the middle portion is the largest, and the upper end is intermediate in dimensions between the other two. Form and size.

After the vagina has been laid open by an incision along the upper wall, the position of the uterus in that wall, instead of at the extremity, may be remarked; and further, the tube can be seen to extend higher on the posterior than the anterior aspect of the cervix uteri. On the inner surface, towards the lower part, is a slight longitudinal ridge both in front and behind, named *columns* of the vagina. Before the tissue of the vagina has been distended, other transverse ridges or *rugæ* may be seen passing between the columns. Interior has columns and rugæ.

Wall. The wall of the vagina is thicker anteriorly, where the urethra is situate, than at any other part of the canal.

An erectile structure in the wall. *Structure.* — The vaginal wall is formed by a spongy erectile tissue; this is covered externally by a muscular layer, and lined internally by mucous membrane. At its lower end the tube is surrounded by a band of the fibres of the sphincter vaginæ muscle (p. 462.).

Erectile tissue The *erectile* tissue is more abundant at the ends than the middle of the vagina, and in greatest quantity below where it gives increased thickness to the wall.

forms semi-bulbs, Two masses of the erectile tissue, one on each side of the opening of the vagina, have been described as the *semi-bulbs* by Taylor, and as the *bulbi vestibuli* by Kobelt. These are elongated masses of plexiform veins, about an inch in length, which are enclosed in fibrous membrane, and are situate one on each side of the vestibule, where they are covered on the outer side by the constrictor vaginæ. At its upper part each is pointed, is continued to the clitoris, and communicates with the vessels of that body; whilst at the posterior rounded part it joins the venous plexus of the vagina. These bodies are supposed by Kobelt to be the homologue of the bulb of the corpus spongiosum urethræ in the male; but in the female this corresponding part is split, instead of forming one piece in the middle line, and each lateral half is thrust aside towards the crus clitoridis by the large aperture of the vagina.

which correspond to the bulb of the male.

Mucous membrane of the vagina. The *mucous membrane* is continued through the lower aperture, over the vessels of the nymphæ, which it encloses, to join the integument on the labia majora; and through the os uteri, at the opposite end, to the interior of the uterus. Many muciparous glands and follicles abound on the surface, but these are in greatest abundance at the upper part. The papillæ on the surface are conical or filiform in shape. A laminar *epithelium* gives a lining to the membrane.

Muscular stratum. The *muscular* layer is outside the erectile structure, and consists of longitudinal fibres; some reach all along the vagina; others, and these are the strongest, only as far upwards as the recto-vesical fascia, to which they are attached on each side. Above they end in the superficial layer of the uterus and in the peritoneum, but below in the subdermic tissue.

Arteries. *Bloodvessels and nerves.* — The *arteries* are derived from the

visceral branches of the internal iliac. The *veins*, corresponding with the arteries, form a plexus around the vagina, as well as in the external or genital organs, and open into the internal iliac vein. For a description of the nerves see page 617. Veins are plexiform.

Glands of Bartholine.—On the outer part of the vagina, near the aperture at the lower end, are two small yellowish glandular bodies, one on each side, which correspond with Cowper's glands in the male. Each is about the size of a small bean; it is provided with a duct, that is directed forwards to open on the inner aspect of the nympha of its own side of the body. Two glands analogous to Cowper's.

THE UTERUS.

The uterus or womb is formed chiefly of unstriped muscular fibres. Its office is to receive and retain for a fixed period the developing ovum. Uterus: definition;

This viscus, in the virgin state, is pear-shaped, or rather triangular in consequence of the body being flattened, and presents inferiorly a rounded narrow part or neck. Deviations from the standard shape will be found in this organ in the infant state, where the neck is larger than the body; and in the aged female, in whom there is little separation between the same two parts. form; how changed.

Commonly the uterus measures about three inches in length, two in breadth at the upper part, and an inch in greatest thickness. Its weight varies from an ounce to an ounce and a half. But after gestation its size and volume always exceed the specification here made of them. Dimensions.

The *upper* end is convex, and is covered by peritoneum: the term *fundus* is applied to the part of the organ above the attachment of the Fallopian tube. The *lower* end is small and rounded, and in it is a transverse aperture of communication between the uterus and the vagina, named *os uteri* (*os tincæ*), whose margins or lips (labia) are smooth, and anterior and posterior in situation, but the hinder one is the longest. Towards the lower part the uterus is constricted, and this diminished portion is called the neck of the uterus (*cervix uteri*); it is surrounded by the vagina, and is covered by this tube to a greater extent behind than in front. It is about half an inch in length, and gradually tapers towards the ex- Upper end. The lower end is small; has an opening. Neck;

body; tremity. The *body*, or the intervening part of the uterus, is more convex posteriorly than anteriorly, and decreases in size down to the neck. It is covered on both aspects by the peritoneum, except about half an inch in front at the lower part, where it is connected to the bladder. sides. To each side, which is straight, the parts contained in the broad fold of the peritoneum are attached, viz. the Fallopian tube at the top, the round ligament rather below and before it, and the ovary and its ligament below and behind the others.

Open the uterus. *Dissection.*—To examine the interior of the uterus, a cut is to be made along the anterior wall, from the fundus to the os uteri; and then enough of the tissue is to be taken away on each side of the middle line to show the contained cavity.

Its thickness. The *thickness* of the uterine wall is greatest opposite the middle of the body, and at the centre of the fundus; but from those spots the wall becomes thinner towards the attachment of the Fallopian tubes.

In the interior *Interior of the uterus.*—Within the uterus is a small space, which is artificially divided into two—one of the body, is a triangular space in the body, another of the neck of the organ. The *space* occupying the *body* of the viscus is triangular in form, and is larger than the other. The base is at the fundus of the uterus, where it is convex towards the cavity, and the angles are prolonged which is narrowed below, towards the Fallopian tubes. The apex is directed downwards, and joins the cavity in the cervix by a narrowed circular part, *isthmus* (os uteri internum). and a spindle-shaped space in the neck. The *space* within the *neck* terminates inferiorly at the os uteri; and above at the space within the body, as before said, but this last opening may be smaller than the one into the vagina. It is larger at the middle than at either end, being spindle-shaped, and is somewhat flattened, like the cavity of the body. Along both the anterior and the posterior wall is a longitudinal ridge, and other ridges (*rugæ*) are directed obliquely from these on each side: In the neck are ridges or the arbor vitæ. this appearance has been named *arbor vitæ uterinus.* In the intervals between the rugæ are some mucous follicles, which sometimes become filled and distended with fluid, and gave rise to the *ovula of Naboth.*

Uterus is a muscular organ. STRUCTURE.—The dense wall of the uterus is composed of layers of unstriated muscular fibre, intermixed with dense connective and elastic tissues, and large bloodvessels. On

the exterior is the peritoneum, and lining the interior is a thin mucous membrane.

The *muscular* fibres can be demonstrated at the full period of gestation to form three strata in the wall of the uterus, viz. external, internal, and middle. The *external* layer contains fibres which are mostly transverse; but at the fundus and at the sides they are oblique, and there they are more marked than along the middle of the organ. Externally the fibres converge towards the broad ligament; some are inserted into that membrane; whilst others are prolonged on the Fallopian tube, the round ligament, and the ligament of the ovary. The *internal* fibres describe circles around the openings of the Fallopian tubes, and spread from these till they meet at the middle line of the uterus. At the neck they become transverse in direction. The *middle* or intervening set of fibres are more indistinct than the others, and have a less determinate direction.

There are three strata: external, internal, and middle.

The *mucous* lining is continued into the vagina at one end of the uterus, and into the Fallopian tubes at the other. In the interior of the uterus it is thin, smooth, and adherent, but without papillæ. Like the mucous membrane of the intestine, it possesses tubular *glands*, which may be either straight and simple, or may be twisted or branched; the apertures of these are scattered over the surface. In the cervix uteri, between the rugæ, mucous *follicles* and glands are collected, and near the outer opening are filiform papillæ.

Mucous lining is covered with glands. Follicles in the neck.

The *epithelial* covering of the mucous membrane is columnar and ciliated as low as the middle of the cavity of the neck, but laminar beyond that point.

Epithelium.

The *bloodvessels* of the uterus are large and tortuous; and the veins occupy canals in the uterine substance, in which they communicate freely together. The *arteries* are furnished from the uterine and ovarian branches; the *veins* correspond with the arteries in name and number. The *nerves* are derived from the sympathetic, and are very small in proportion to the size of the uterus: they are not enlarged in pregnancy.—Beck.*

Vessels are large. Arteries; veins; nerves.

Round ligament of the uterus.—This firm cord supports the uterus, and is contained partly in the broad ligament, and partly in the inguinal canal (p. 482.). It is about four or five inches in length, and is attached to the upper part of

Round ligament ends in groin. Attachment to

* See a Paper in the *Philosophical Transactions* for 1846.

uterus; the uterus close below, and anterior to the Fallopian tube. A process of the peritoneum accompanies the part of the cord in the inguinal canal, and sometimes remains pervious for a short distance. The ligament is composed of unstriated muscular fibres, derived from the uterus, together with vessels and connective tissue. It is said to have some transversely striated muscular fibres.

how formed.

OVARIES AND FALLOPIAN TUBES.

Ovary: position;

OVARY.—The ovaries are two bodies, corresponding with the testes of the male; they are contained in the broad ligaments of the uterus, one in each, and at the posterior aspect.

form and colour; dimensions and weight.

Each ovary is of an elongated form, and somewhat flattened from above down; it is of a whitish colour, with either a smooth or a scarred surface. Its volume is variable, but in the virgin state it is about one inch and a half in length, half that size in width, and a third in thickness; its weight is nearly a quarter of an ounce.

Connections.

The ovary is connected with the broad ligament by its anterior margin, where the vessels enter it. Its outer end is rounded and is connected with one of the fimbriæ at the mouth of the Fallopian tube; but the inner extremity is narrowed, and is attached to the side of the uterus by a fibrous cord, the ligament of the ovary, which is below the level of both the Fallopian tube and the round ligament.

Glandular in structure.

Structure.—The ovary consists of a fibrous vascular stroma of connective tissue, which contains small vesicles or ovisacs, named Graafian, and is enclosed within a fibrous tunic. The peritoneum surrounds the whole, except at the attached margin.

A fibrous coat surrounds stroma.

The special *fibrous* coat (tunica albuginea) is of some thickness and of a whitish colour, whence its name, and is adherent to the contained stroma. Sometimes a yellow spot (corpus luteum) or some fibrous cicatrices may be seen in this covering.

In the stroma are small vesicles.

The ovisacs or the *Graafian vesicles* are small round transparent bodies, and are from eight to twenty in number in women who have not borne children: they vary in size from a pin's head to a pea, and are scattered through the

stroma of the ovary. They are largest in size towards the circumference of the organ, and sometimes they may be seen projecting through the fibrous coat. Size and number.

Each consists of a transparent coat, and contains a fluid. The coat of the vesicle, named *ovi-capsule* (tunica fibrosa), is formed of fine connective tissue, and is united to the stroma of the ovary by a network of bloodvessels, which ramify in the wall of the ova: lining it is a layer of nucleated cells—the *membr. granulosa* of Baer. The fluid in the interior is transparent and albuminous; and in it is suspended the minute vesicular ovum, together with molecular granules. Coat; contents.

When the Graafian vesicle is matured it bursts on the surface of the ovary, and the contained ovum escapes into the Fallopian tube. After the shedding of the ovum the ruptured vesicle gives origin to a yellow substance, *corpus luteum*, which finally changes into a cicatrix. Shedding of a vesicle. Formation of corpus luteum.

Bloodvessels and nerves.—The ovarian *artery* pierces the ovary at the anterior or attached border, and its branches run in zigzag lines through the stroma. The *veins* begin in the follicles and texture of the ovary, and after escaping from its substance, form a plexus (*pampiniform*) near the ovary, and within the fold of the broad ligament. The *nerves* are derived from the sympathetic on the ovarian and uterine vessels. Artery; veins; nerves.

Fallopian Tubes.—These tubes convey the ova from the ovaries to the uterus, and correspond in their office with the vasa deferentia in the male. Fallopian tubes; use,

The tubes are two in number, one on each side. Each is about four inches in length: it is cord-like at the inner end, where it is attached to the upper part of the uterus, but increases in size towards the outer end, and terminates in a wide extremity, like the mouth of a trumpet. This dilated end is fringed and named *corpus fimbriatum*, and the serrations of its circumference are called fimbriæ: when the fimbriated end is floated out in water, one of the processes may be seen to be connected with the outer end of the ovary. In the centre of the fimbriæ is a groove, that leads to the orifice of the Fallopian tube. length, and form. It is dilated externally, and fimbriated.

On opening the tube with care, the size of the contained space, and the small aperture into the uterus can be observed. Its canal varies in size at different spots;—the narrowest part is at the orifice into the uterus, where it scarcely gives Size of the tube is least at the ends.

passage to a fine bristle; towards the outer end it increases a little, but it is again rather diminished in diameter at the outer aperture.

A muscular structure. *Structure.* — This excretory tube has the same structure as the uterus with which it is connected, viz. a muscular tunic, which is covered externally by peritoneum, and lined by mucous membrane.

Fibres prolonged from uterus. The *muscular* coat is formed of an external or longitudinal, and of an internal or circular layer; both these are continuous with similar strata in the wall of the uterus.

Mucous coat The *mucous membrane* forms some longitudinal folds, particularly at the outer end. At the inner extremity of the canal it joins the mucous lining of the uterus, but at the is continuous with peritoneum. outer end it is continuous with the peritoneal covering. A columnar ciliated *epithelium* covers the surface, as in the uterus.

Vessels. The *bloodvessels* and *nerves* are furnished from those that supply the uterus and the ovary.

THE BLADDER, URETHRA, AND RECTUM.

Anatomy of the bladder, given before. Bladder.—The peculiarities in the form and size of the female bladder have been noticed in the description of the connections of the viscera of the female pelvis (p. 605.). For a notice of its structure, the anatomy of the male bladder is to be referred to (p. 621.)

Preparation of it. *Dissection.* — To prepare the bladder, distend it with air, and remove the peritoneal covering and the loose tissue from the muscular fibres. The urethra is to be slit open along the upper part with the bladder, after their external anatomy has been learnt.

Length of urethra; Urethra.—The length and the connections of this excretory tube are given in page 605.

size; The average diameter of the tube is rather more than a quarter of an inch, and the canal is enlarged and funnel-shaped towards the neck of the bladder. Near the external it can be much dilated. aperture there is a hollow in the floor of the tube. In consequence of not being surrounded by such resistant structures, the urethra is much more dilatable than the corresponding passage in the male.

Tube like that in the male. *Structure.*—This tube, like the urethra of the male, consists of a mucous coat, which is enveloped by a plexus of bloodvessels, and by muscular fibre.

The *muscular* coat extends the whole length of the tube. Its fibres are circular, and continuous behind with the middle layer of the bladder. This covering is between the constrictor urethræ and submucous layer, as in the male (p. 457.) and the part nearest the bladder will correspond with the prostatic enlargement in the other sex. Muscular coat of circular fibres.

The *mucous* coat is pale except near the outer orifice. It is marked by longitudinal folds; and one of these, in the floor of the canal, resembles the median crest in the male urethra (p. 625.). Around the outer orifice are some mucous *follicles*; and towards the inner end are some tubular mucous *glands*, whose apertures are arranged in lines between the folds of the membrane, and are turned towards the bladder. A laminar *epithelium* is spread over the surface, which becomes irregular in form (spheroidal) at the bladder. Mucous coat. A fold in floor. Follicles and glands. Epithelium.

A *submucous* stratum of longitudinal elastic and muscular tissues lies, as in the male, close to the mucous membrane. Submucous tissue.

Rectum.—The structure of the rectum is so similar in the two sexes that the student may use the description given for that tube in the Section on the anatomy of the viscera of the male pelvis (p. 631.). Rectum like that of the male.

Dissection.—The rectum may be prepared for examination by distending it with air, and removing the peritoneal covering and the areolar tissue from it. Preparation of rectum.

Section VII.

INTERNAL MUSCLES AND THE LIGAMENTS OF THE PELVIS.

Muscles.—The two following muscles, pyriformis and obturator internus, have their origin within the cavity of the pelvis. Two muscles.

The pyriformis muscle is wide and fleshy within the pelvis, and is directed outwards through the great sacrosciatic notch to be inserted into the great trochanter of the femur. Narrowing in its progress, the muscle has received its name from its form. Pyriformis. Situation.

In the pelvis the pyriformis is attached by three slips to the second, third, and fourth pieces of the sacrum, both between, and external to the anterior apertures; as it passes from the pelvis, it takes origin also from the surface Origin in the pelvis.

of the hip bone which forms the upper part of the large sacro-sciatic notch, and from the great sacro-sciatic ligament. From this origin the fibres converge to the tendon

Insertion.

of *insertion* into the trochanter. (See DISSECTION OF THE BUTTOCK.) The anterior surface is in contact with the

Its connections with parts around.

rectum, with the sacral plexus, and with the sciatic and pudic branches of the internal iliac vessels; whilst the opposite surface rests on the sacrum, and is covered by the great gluteal muscle outside the pelvis. The upper border is near the hip bone, but between them are the gluteal vessels and the superior gluteal nerve; and the lower is contiguous to the coccygeus muscle, only the sciatic and pudic vessels and nerves intervening.

Obturator muscle is bent over pelvis.

The OBTURATOR INTERNUS MUSCLE, like the preceding, has its origin in the pelvis, and its insertion out of the cavity at the great trochanter of the femur; but the part outside is almost parallel in direction with that inside the pelvis.

Origin in the pelvis.

The muscle *arises* by a broad fleshy attachment from the inner surface of the obturator membrane, and from the fibrous arch bounding the canal containing the obturator vessels and nerve; slightly from the surface of bone internal to the membrane; and from all the smooth surface of the hip bone behind the thyroid hole, reaching upwards to the brim, downwards to the outlet, and backwards to the great

Arching of its tendons over the hipbone.

sacro-sciatic notch of the pelvis. The fibres are directed backwards and somewhat downwards, and end in four or five tendinous pieces, which turn over the sharp pulley-like surface at the back of the bone corresponding with the space of the small sacro-sciatic notch. Outside the pelvis these

Insertion.

tendons are blended into one, which is fixed into the great trochanter, and is met with in the dissection of the buttock.

Part of muscle is in pelvic cavity,

The pelvic portion of the muscle is in contact by one side with the wall of the pelvis and the obturator membrane; by the other side with the fascia lining the pelvic wall, and towards its lower border with the pudic vessels and nerve.

part in perinæal space.

Above the level of the levator ani, viz. from the lower part of the symphysis pubis to the ischial spine, the muscle corresponds with the cavity of the pelvis, but below that line, with the ischio-rectal fossa.

Coccygeus

COCCYGEUS MUSCLE.—The position and the connections of

this muscle may now be studied in the interior of the pelvis. The muscle is described at p. 591. muscle.

ARTICULATIONS OF THE PELVIS.

The several bones of the pelvis have the following articulations with one another. The sacrum is joined by its base to the last lumbar vertebra, and by its apex to the coccyx, by special ligaments. Laterally, this central bone is united with the two innominate bones. And the innominate bones are connected together in front, as well as to the sacrum and the spinal column posteriorly. **Outline of the articulations.**

SACRO-VERTEBRAL ARTICULATION. — The base of the sacrum is articulated with the last lumbar vertebra by ligaments similar to those uniting one vertebra to another (p. 400.); and by one special ligament — the sacro-vertebral. **Union of sacrum with last vertebra.**

Dissection. — For the best manner of bringing these different ligaments into view, the dissector must consult the directions that have been given respecting the dissection of the ligaments of the vertebræ (p. 400.). **Dissection.**

The *common ligaments* between the bodies of the two bones are an anterior and a posterior, with an intervening fibro-cartilaginous substance. Between the neural arches are the ligamenta subflava; between the spines, the supra and interspinous bands; and between the articular processes are capsular ligaments and synovial membranes. **By ligaments as in the vertebræ,**

The *sacro-vertebral* ligament is a strong bundle of fibres, which reaches from the under aspect of the tip of the transverse process of the last lumbar vertebra, to the lateral part of the base of the sacrum. Widening as it descends, the ligament spreads, and joins the fibres in front of the lateral articulation between the sacrum and the innominate bone. **and by a special band, sacro-vertebral.**

SACRO-COCCYGEAL ARTICULATION. — The sacrum and the coccyx are united by a fibro-cartilage, and by an anterior and a posterior common ligament. **Union of sacrum and coccyx.**

Dissection. — Little dissection is necessary for these ligaments. When the connective tissue has been removed altogether from the bones, the ligaments will be apparent. **Dissection.**

The *anterior ligament* (sacro-coccygeal) consists of a few **An anterior and**

fibres that pass between the bones in front of the fibro-cartilage.

a posterior ligament, The *posterior ligament* is wide at its attachment to the lower margin of the orifice of the sacral canal, but narrows as it descends to be inserted into the coccyx.

and a fibro-cartilage. The *fibro-cartilage* resembles that between the vertebræ, and is attached to the surfaces of the bones.

Union of the pieces of the coccyx. Whilst the several pieces of the coccyx remain separate, they are connected together by *anterior* and *posterior* bands, and by intervening thin *fibro-cartilages.* But in the male adult the bones are generally joined by ossific matter.

Union between the sacrum and hip bone. SACRO-ILIAC ARTICULATION. — The irregular surfaces by which the sacrum and the innominate bone touch, are united by cartilage, and maintained in contact by anterior and posterior sacro-iliac ligaments. Inferiorly the bones are further connected, without being in contact, by the strong sacro-sciatic ligaments.

To dissect the ligaments. *Dissection.* — To see the posterior ligaments, the mass of muscle at the back of the sacrum is to be removed on the side on which the innominate bone remains; but the anterior bands will be visible on the removal of some connective tissue. The great sacro-sciatic ligament is dissected with the lower limb, and the small ligament will be brought into view by removing the coccygeus.

Anterior The *anterior sacro-iliac* ligament consists of a few thin scattered fibres, which are attached to the sacrum and the hip bone near their articular surfaces.

and posterior ligaments; The *posterior ligaments* (sacro-iliac) are much stronger than the anterior, and the fibres are collected into bundles. These ligaments pass from the rough inner surface at the posterior extremity of the innominate bone to the first two pieces of the sacrum. One bundle, which is distinct from the others, and more superficial, is named the *oblique* or *long posterior* ligament; it is attached to the posterior superior iliac spinous process, and descends almost vertically to the third piece of the sacrum.

one more distinct than the rest,

with articular cartilage. *Articular cartilage.* — Between the irregular surfaces of the bones in this articulation (sacro-iliac symphysis) is a thin uneven layer of cartilage. In it there is sometimes a hollow with irregular surfaces like that in the cartilage of the symphysis pubis. On separating the bones, after the other liga-

ments are examined, the cartilage may be detached with a knife.

Two *sacro-sciatic ligaments* pass from the lateral part of the sacrum and coccyx to the ischial spine and tuberosity of the hip bone, across the space at the back of the pelvis between the posterior border of that bone and the sacrum. By their position they convert into two apertures or foramina (sacro-sciatic), the large sacro-sciatic excavation in the dried bones: these openings, and the parts they give passage to, are described in the dissection of the buttock. The ligaments are named large and small. Sacro-sciatic ligaments are two;

The *large* ligament reaches from the side of the sacrum and coccyx to the ischial tuberosity; but it may have been cut in the dissection of the gluteal region, with which it is examined. large;

The *small* ligament is attached internally by a wide part to the border of the sacrum and coccyx, where it is united with the origin of the preceding ligament. The fibres are directed outwards to the ischial spine of the hip bone, and are inserted into it by a narrowed part. Its pelvic surface is covered by the coccygeus muscle, and its opposite surface by the great sacro-sciatic ligament. Above this ligament, between it and the bone, is the large sacro-sciatic foramen, and below it is the small foramen of the same name. small; attachments and connections.

LIGAMENTS OF THE INNOMINATE BONES.—The innominate bones are united in front, at the pubic symphysis, by an interposed cartilage and special ligaments; and behind, each is connected with the transverse process of the last lumbar vertebra by a special band (ilio-lumbar). In the centre of the bone is a membranous structure closing the thyroid aperture. Special ligaments of the lateral bones of the pelvis.

The *ilio-lumbar ligament* is triangular in form and is divided into fasciculi. Internally it is attached to the tip of the transverse process of the last lumbar vertebra; externally the fibres spread out, and are inserted into the iliac crest, opposite the posterior part of the iliac fossa on the inner aspect. To the upper border of this ligament the fascia lumborum is attached: its posterior surface is covered by the quadratus lumborum, and its anterior by the iliacus muscle. Ilio-lumbar fixes the bone behind.

Obturator membrane closes an aperture in front.

The *obturator membrane* closes the thyroid foramen, and is composed of fibres crossing in different directions. It is attached at the outer and upper part to the bony margin of the foramen, except above where the obturator vessels lie; and is connected towards the inner part to the pelvic aspect of the bone. The surfaces of the ligament give attachment to the obturator muscles. Branches of the obturator artery and nerve perforate it.

Union at the pubes.

Pubic Articulation (symphysis pubis).—The oval pubic surfaces of the hip bones are united by cartilage, and by fibres in front of, and above the bones. They are also connected by a strong subpubic ligament.

Anterior band.

The *anterior pubic ligament* is very strong and is formed of different layers of fibres. The superficial are oblique, and cross one another, uniting with the aponeurosis of the external oblique muscle of the abdomen; but the deeper fibres are transverse, and pass between the surfaces of the bones. Some of the deeper fibres contain cartilage cells — Kölliker. There is not any *posterior* band; but beneath the periosteum there are a few scattered fibro-cartilaginous fibres, as in front, in contact with the cartilage.

Superior band.

The *superior* ligamentous bands are placed as their name expresses.

Subpubic ligament.

The *subpubic ligament* (ligam. arcuatum) is a strong triangularly-shaped band below the symphysis, and occupies the upper part of the pubic arch. Its fibres curve downwards, and are attached on each side to the bone. The apex of the ligament touches the articular cartilage, and the base is turned towards the membranous part of the urethra and the muscle around it.

Cartilage, how seen;

Cartilage.—This structure will be best seen by opening the articulation behind: a transverse section will also show the disposition of the anterior ligament of the articulation.

disposition in the symphysis;

The cartilage joins the bones in front, and is firmly fixed to the ridged bony surfaces of the symphysis. It is larger above than below, and is generally as thick again before as behind; its size seems to depend on the shape of the bones, and not on difference in the sex.

hollow in it.

Towards the posterior part of the cartilaginous mass a

hollow *, with uneven walls and a synovial-looking fluid, is excavated. Here the structure is distinctly fibrous, with large interspersed compound cells. This space varies in size. It usually extends the whole depth of the cartilage, reaching also in some bodies through the whole thickness from before back so as to divide the mass into two collateral pieces ; in others projecting through only a half or a third of the cartilage.

* This hollow is said to increase in pregnancy.

TABLE OF THE ARTERIES OF THE ABDOMEN.

The Abdominal Aorta gives off

- 1. Phrenic.
- 2. cœliac axis* -
  - Coronary - Œsophageal gastric.
  - hepatic -
    - Superior pyloric
    - gastro-epiploïc - Inferior pyloric, pancreatico-duodenal.
    - left hepatic branch
    - right hepatic branch - Cystic.
  - splenic -
    - pancreatic
    - vasa brevia
    - splenic
    - left gastro-epiploïc.
- 3. superior mesenteric*
  - Pancreatic
  - intestinal
  - ileo-colic
  - right colic
  - middle colic.
- 4. middle capsular
- 5. renal
- 6. spermatic
- 7. inferior mesenteric*
  - Left colic.
  - sigmoid
  - superior hæmorrhoidal.
- 8. lumbar
- 9. middle sacral*
- 10. common iliac
  - External iliac -
    - Epigastric - Pubic branch, anastomotic, cremasteric.
    - circumflex iliac
  - internal iliac -
    - Parietal branches -
      - Ilio-lumbar
      - lateral sacral
      - gluteal - Superficial, deep.
      - sciatic - Coccygeal, comes nervi ischiadici, muscular.
      - pudic -
        - Visceral
        - inferior hæmorrhoidal
        - superficial perinæal
        - transverse perinæal
        - artery of the bulb
        - to corpus cavernosum
        - dorsal artery.
      - obturator - Articular.
    - visceral branches -
      - Middle hæmorrhoidal
      - vesical
      - uterine
      - vaginal.

* The branches marked with an asterisk are single.

TABLE OF THE VEINS OF THE ABDOMEN.

- INFERIOR VENA CAVA receives
  - 1. Common iliac
    - Internal iliac
      - Visceral branches
        - Hæmorrhoidal plexus
        - vesico-prostatic plexus
          - Vesical
          - dorsal of the penis
          - deep veins of the penis.
        - uterine
        - vaginal.
      - parietal branches
        - Obturator
        - pudic
          - Veins of corpus cavernosum
          - of the bulb
          - transverse perinæal
          - superficial perinæal
          - inferior hæmorrhoidal.
        - sciatic
          - coccygeal
          - comes nervi ischiadici
          - muscular.
        - gluteal.
    - external iliac
      - Epigastric
      - circumflex iliac.
    - ilio-lumbar
    - lateral sacral
    - middle sacral into the left.
  - 2. vertebro-lumbar
  - 3. right spermatic
  - 4. renal
    - Right
    - left
      - capsular
      - spermatic.
  - 5. right capsular
  - 6. diaphragmatic
  - 7. vena portæ by means of the hepatic veins
    - Splenic
      - Splenic branches
      - vasa brevia
      - pancreatic
      - left gastro-epiploïc.
      - inferior mesenteric
        - Left colic
        - sigmoid
        - superior hæmorrhoidal.
    - superior mesenteric
      - Intestinal
      - ileo-colic
      - right colic
      - middle colic
      - right gastro-epiploïc
      - pancreatic.
    - coronary
    - cystic.

TABLE OF THE SPINAL NERVES IN THE ABDOMEN.

- **Lumbar spinal nerves** divide into
  - Posterior branches
    - Internal — Muscular.
    - external — Muscular; cutaneous.
  - Anteriorbranches; of these the four first end in the LUMBAR PLEXUS*, which supplies
    - Ilio-hypogastric — Cutaneous of the ilium; hypogastric branch.
    - Ilio-inguinal — To integuments of the groin.
    - external cutaneous — To integuments of the thigh.
    - genito-crural — Genital branch; crural branch.
    - anterior-crural
      - Branches inside the pelvis — To the iliacus muscle. To the femoral artery.
      - Branches outside the pelvis — are noticed in the thigh.
    - obturator — Accessory — Other offsets are described in the thigh.

- **Sacral spinal nerves** divide into
  - Posterior branches unite together and give off — Muscular and cutaneous filaments.
  - The anterior branches of the four superior unite with the lumbo-sacral in the SACRAL PLEXUS†, and furnish
    - Branches inside the pelvis — Visceral; to levator ani; to obturator internus; to the pyriformis.
    - branches outside the pelvis
      - pudic — Inferior hæmorrhoidal; superficial perinæal — (*anterior and posterior*); muscular; to the bulb; dorsal of the penis.
      - inferior hæmorrhoidal (*sometimes*).
      - To the superior gemellus; to the inferior gemellus and the quadratus; articular; small sciatic; great sciatic — these are described in the thigh.

* The lumbo-sacral gives off the superior gluteal nerve.
† The other sacral nerves are described at p. 614.

TABLE OF THE SYMPATHETIC NERVE OF THE ABDOMEN.

Solar plexus* or prevertebral centre of the abdomen, furnishes the following plexuses:

- Diaphragmatic
- cœliac - - -
  - Coronary plexus
  - hepatic - -
    - Pyloric
    - right gastro-epiploïc
    - pancreat.-duodenal
    - cystic.
  - splenic - - -
    - Left gastro-epiploïc
    - pancreatic.
- superior mesenteric - Offsets to small and large intestine.
- suprarenal
- renal - - - Spermatic plexus, filaments to the.
- aortic - - - Hypogastric.
- spermatic
- inferior mesenteric -
  - Offsets to the large intestine
  - Superior hæmorrhoidal.

Hypogastric plexus† ends in the pelvic plexus on each side, which gives the following plexuses:

- Inferior hæmorrhoidal
- vesical - - -
  - Prostatic
  - cavernous
  - deferential
  - to vesiculæ seminales.
- uterine
- vaginal.

Gangliated cord of the sympathetic in the abdomen supplies

- External branches - To the lumbar and sacral spinal nerves.
- internal - -
  - To aortic plexus
  - to hypogastric plexus
  - to join round middle sacral artery
  - between the cords on the coccyx, in the *ganglion impar*.

* This receives { Great splanchnic nerves; part of small splanchnic; offset of pneumo-gastric.

† This is joined above by - { The aortic plexus; filaments from the lumbar ganglia.

PNEUMO-GASTRIC NERVE IN THE ABDOMEN.

Pneumo-gastric -

- Right - -
  - Coronary branches to the back of the stomach
  - filaments to join the cœliac and splenic plexuses.
- left - -
  - Coronary branches to the front of the stomach and the hepatic plexus.

CHAPTER IX.

DISSECTION OF THE LOWER LIMB.

Section I.

THE FRONT OF THE THIGH.

Directions. All the parts described in Section I. are to be examined before the time for turning the body arrives.

Position of the body. *Position.*—During the dissection of the front of the thigh the body should lie on the back, with a block of a suitable size beneath the pelvis, and the lower limbs should hang over the end of the dissecting table. The limb is to be rotated outwards, so as to make evident a hollow at the upper part of the thigh; and is to be supported in a half bent position by means of a stool beneath the foot.

Objects on the surface. *Surface marking.*—Before any of the integument is removed from the limb, the student is to observe the chief markings and eminences on the surface of the thigh.

Prominences limiting the thigh above. The limit between the thigh and the abdomen is marked in front by the firm band of Poupart's ligament intervening between the crest of the hip bone and the pubes. On the outer side the division is indicated by the convexity of the iliac crest of the innominate bone, which subsides behind in the sacrum and coccyx; and on the inner side, by the projection of the pubes, from which a line of bone (pubic arch) may be traced backwards along the inner and upper part of the limb to the ischial tuberosity.

Hollow of Scarpa's space. On the anterior aspect of the thigh, and close to Poupart's ligament, is a slight hollow, corresponding with the triangular space of Scarpa, in which the larger vessels of the limb are contained; and extending thence obliquely along the inner side of the limb, is a slight depression marking the situation

Groove of the femoral artery beneath: the position of this arterial

trunk may be ascertained by a line on the surface from the centre of the interval between the symphysis pubis and the crest of the hip bone, to the inner condyle of the femur. On the outer side of the thigh, about four inches below the iliac crest and the same distance from the anterior spine, the student will be able to recognise the well-marked projection of the great trochanter of the femur. In a thin body the head of the femur may be felt by rotating the limb inwards and outwards, whilst the thumb of one hand is placed in the hollow below Poupart's ligament, and the fingers behind the great trochanter.

over femoral artery.

Position of great trochanter.

Head of the femur.

At the knee the outline of the several bones that enter into the formation of the joint may be traced with ease. Thus, in front of the joint, when it is half bent, the rounded prominent patella may be perceived; this is firmly fixed whilst the limb is kept in the same position, but is moved with great freedom when the joint is extended so as to relax the muscles that are inserted into it. On each side of the patella is the projection of the condyle of the femur, but that on the inner side is the largest. If the fingers are passed along the sides of the patella whilst the joint is half bent, they will be conducted by the condyles of the femur to the tuberosities of the head of the tibia, and to a slight hollow between the bones. Behind the joint is a slight depression over the situation of the ham or popliteal space; and on its sides are firm boundaries, formed chiefly by the tendons (hamstrings) of the flexor muscles of the leg.

Bony eminence of knee.

Patella.

Condyles of the femur.

Tuberosities of the tibia.

The ham behind.

Dissection.—With the position of the limb the same as before directed, the student begins the dissection with the examination of the subcutaneous fatty tissue with its nerves and vessels.

Dissection.

At first the integument is to be reflected only from the hollow on the front of the thigh close below Poupart's ligament. To raise the skin from this part an incision about four inches in length, and only skin deep, is to be made from the pubes along the inner border of the thigh: at its lower end another cut is to be directed outwards across the front of the limb to the outer aspect; and at its upper end the knife is to be carried along the line of Poupart's ligament as far as the crest of the hip bone. The piece of skin included by these incisions is to be raised

Take up the skin at the top of the thigh.

and turned outwards, without taking with it the subcutaneous fat.

Superficial fascia, how formed; The *superficial fascia* forms a general investment for the limb, and is constructed of a network of areolar tissue, with fat or adipose substance amongst the meshes. As a part of the common covering of the body, it will be found continuous with that of the neighbouring regions, so that it may be followed inwards to the scrotum or labium, and upwards on the abdomen. Its thickness varies in different bodies, according to the quantity of fat deposited in it; and at the upper part of the thigh it is divided into two strata (superficial and deep) by some cutaneous vessels and inguinal glands. The superficial of the two layers is now apparent after the removal of the skin, but its connections will be made more evident by the following dissection.

thickness varies; it is divided into two strata by vessels.

To raise the superficial stratum. *Dissection.*—To reflect the superficial stratum of the fascia, incisions similar to those in the skin are to be employed; and the separation from the subjacent structures is to be begun at the lower part, where the large saphenous vein, and a condensed or membranous appearance on the under surface, will mark the depth of the stratum. The handle of the scalpel may be advantageously employed in raising the fascia along the middle line of the limb; but, where vessels and glands are not found, viz. along the outer and inner borders of the thigh, the separation of the superficial fascia into two layers cannot be easily made.

Subcutaneous layer of the fascia The *subcutaneous layer* of this fascia decreases in thickness near Poupart's ligament, becoming more fibrous at the same spot; and at its under aspect is a smooth and membranous surface. It conceals the superficial vessels and the inguinal glands, and is separated by these from Poupart's ligament, so that it is unconnected to that band as it passes upwards to the abdomen, and is readily moved on it either upwards or downwards.

is not united with Poupart's ligament.

Dissection. *Dissection.*—The inguinal glands and the superficial vessels are to be next laid bare by the removal of the surrounding fat, but the student is to be careful not to destroy the deeper, very thin layer of the superficial fascia which is beneath them, and chiefly to the inner side of the centre of the limb.

To see Three sets of vessels are to be found in the dissection:

one set (artery and vein) is directed inwards to the pubes, and named external pudic; another, superficial epigastric, upwards over Poupart's ligament; and the third, or the superficial circumflex iliac, appears at the outer border of the limb. The large vein in the middle line of the thigh to which the branches converge, is the internal saphenous. Some of the small lymphatic vessels may be traced from one inguinal gland to another. the superficial vessels, lymphatics,

A small nerve, the ilio-inguinal, is to be sought on the inner side of the saphenous vein, and close to the pubes; and one of the terminal branches of the genito-crural nerve may be found a little outside the vein. and nerves.

Superficial Vessels. — The small cutaneous arteries at the top of the thigh are the highest branches of the femoral artery, and are furnished by that trunk as soon as it enters the thigh. The arteries from the femoral.

They pierce the deep fascia of the limb (fascia lata), and are distributed in the integuments and the glands of the groin. A vein accompanies each artery, having the same name as its companion vessel, and ends in the upper part of the saphenous vein; but the description of these veins will be given in a subsequent page (659.). Veins join the saphenous.

The *external pudic* artery (superior) crosses the spermatic cord in its course inwards, and ends in the integument of the penis and scrotum, where it anastomoses with offsets of the internal pudic artery. Another external pudic branch (inferior) pierces the fascia lata at the inner border of the thigh, and ramifies also in the scrotum. In the female these branches supply the labium pudendi. One external pudic artery; another beneath the fascia.

The *superficial epigastric* artery passes over Poupart's ligament to the lower part of the abdomen (p. 469.), and communicates with branches of the deep epigastric artery. Superficial epigastric.

The *superficial circumflex iliac* artery is the smallest of the three branches; and appearing on the outer border of the thigh near the iliac crest, is distributed in the integument. Superficial iliac.

The *superficial inguinal glands* are arranged in two lines; one set lies across the thigh, near Poupart's ligament, and the other along the side of the saphenous vein. In the lower or longitudinal collection the glands are larger than in the upper, and receive the lymphatic vessels from the Inguinal glands; two sets, which receive different

lymphatics. surface of the lower limb; whilst the upper or transverse set are joined by the lymphatics of the penis, and by those of the lower part of the abdomen and the buttocks. The glands vary much in number and size, and not unfrequently those by the side of the vein are united together.

Raise the deep stratum of the superficial fascia. *Dissection.*— The deeper layer of the superficial fascia is to be detached from the subjacent fascia lata, by means of incisions similar to those for reflecting the subcutaneous stratum, except that the lower cut across the thigh is not to be made so far down. The handle of the scalpel is to be employed in the separation, and the dissector is to endeavour to avoid cutting the nerves and vessels. Internal to the saphenous vein a thin membrane can be easily raised, but external to that vessel there scarcely exists a continuous layer distinct from the fascia lata. In reflecting the stratum the margin of an aperture (saphenous) in the fascia lata will be apparent.

Deep part of the superficial fascia The *deeper layer* of the *superficial fascia* is a very thin membraniform stratum, which is most evident near Poupart's ligament, and on the inner side of the saphenous vein. About one inch below the ligament it conceals the large saphenous opening in the fascia lata, and is there pierced by the saphenous vein with some of the ducts of the lymphatic glands. covers saphenous opening, As it stretches across the opening it is connected to the circumference,—internally by loose connective tissue, but externally by firm fibrous bands; and it is connected also with the loose crural sheath of the subjacent vessels in that aperture. The part of this stratum over the saphenous opening is perforated by many small apertures for the transmission of the ducts of the glands, and has been named and part named cribriform fascia. *cribriform* fascia from its sieve-like appearance. In a hernial protrusion through that opening the cribriform portion is projected forwards by the gut, and forms one of the coverings.

Dissection of the front of the thigh. *Dissection.*—Now the student has observed the disposition of the superficial fascia near Poupart's ligament, he may proceed to examine the remainder of this subcutaneous covering of the thigh, together with the vessels and the nerves in it.

To take away the skin, To raise the skin from the front of the thigh, a cut is to be carried along the centre of the limb, over the knee joint,

to rather below the tubercle of the tibia; at its extremity a transverse incision is to be made across the front of the leg, but this is to reach farthest on the inner side. The flaps of the skin may be now reflected inwards and outwards.

The saphenous vein is first to be traced out as far as the skin is reflected, but in removing the tissue from it, the student should be careful of branches of the internal cutaneous nerve that lie along it. and follow saphenous vein.

The cutaneous nerves of the front of the thigh are to be sought in the fat in the following positions: — On the outer margin is the external cutaneous nerve; in the centre are the branches of the middle cutaneous nerve; whilst at the inner margin lie the ramifications of the internal cutaneous nerve, — one small offset appearing near the upper part of the thigh, one or more about the middle, and one of the terminal branches (anterior) about the lower third. Cutaneous nerves of front of thigh,

On the inner side of the knee three other cutaneous nerves are to be looked for: — One is a branch of the great saphenous, which is directed to the front of the patella; another is the trunk of the great saphenous nerve, which lies by the side of the vein of the same name, close to the lower part of the surface now dissected; and the third is a terminal branch (inner) of the internal cutaneous nerve, that is close behind the preceding, and communicates with it. Small cutaneous arteries accompany the nerves. and on side of the knee.

Superficial Veins. — All the veins on the anterior and inner aspects of the thigh are collected into one; and this trunk is named saphenous from the readiness with which it may be detected on the surface. Superficial veins.

The *internal saphenous* vein is the cutaneous vessel of the inner side and front of the lower limb, and extends from the foot to the upper part of the thigh, where it joins the femoral vein. In the part of its course now dissected, the vessel lies somewhat behind the knee joint inferiorly; but as it ascends to its termination, it is directed along the inner side and the front of the thigh. Near Poupart's ligament it pierces the fascia lata by a special opening named saphenous, and enters, as before said, the deep vein of the limb. Superficial branches join it both externally and internally; and near Poupart's ligament the three veins, corresponding with Internal saphenous vein in thigh pierces fascia lata to join the femoral. Veins joining it

may form large trunks at the top of the thigh.

the arteries in that situation, viz. superficial pudic, epigastric, and circumflex iliac, terminate in it. Towards the upper part of the limb the veins of the inner side and the back of the thigh are most frequently united into one branch, which enters the trunk near the aperture in the fascia lata; and sometimes those on the outer side of the thigh are collected together in a similar way, so as to produce three large veins on the front of the thigh near the saphenous opening. On the side of the knee the vein generally receives a deep branch from the joint.

Other cutaneous arteries.

Some unnamed *cutaneous arteries* are distributed to the integuments along with the nerves; and the superficial branch of the anastomotic artery (p. 675.) accompanies the saphenous nerve near the knee.

Cutaneous nerves.

Cutaneous Nerves. — The numerous cutaneous nerves of the thigh are derived from branches of the lumbar plexus (p. 583.), and are distributed in greater abundance on the inner than the outer margin of the limb.

Ilio-inguinal is near scrotum.

Ilio-inguinal. — This nerve (p. 583.) is small in size, and reaches the surface by passing through the external abdominal ring; it supplies the scrotum, and ends in the contiguous part of the thigh, internal to the saphenous vein.

Genito-crural is on front of thigh as far as the middle.

Genito-crural.—The *crural* branch of this nerve (p. 584.) pierces the fascia lata near Poupart's ligament, rather external to the line of the femoral artery. After the nerve has become superficial, it communicates with the middle cutaneous nerve, and extends on the anterior aspect of the thigh as far as midway between the knee and the pelvis. Occasionally this branch is of large size, and, reaching the outer side of the limb, takes the place of branches of the external cutaneous nerve.

External cutaneous is spent on the outer part of the thigh by two branches.

The *external cutaneous* nerve (p. 584.) is distributed on the outer aspect of the limb. At first it is contained in a prominent ridge of the fascia lata on the outer margin of the thigh, where it divides into an anterior and a posterior branch. The *posterior* branch is soon subdivided into two or three others, which arch backwards, supplying the integuments of the outer part of the thigh as low as the middle, and the highest offsets are crossed by branches of the last dorsal nerve. The *anterior* branch extends to the lower half of the thigh. It appears on the surface of the fascia lata, about four inches from Poupart's ligament; and as it is continued to the knee, it distributes branches laterally, but those towards the outer and posterior surfaces are the most numerous, and the largest in size. Near the knee it communicates sometimes with the branch of the great saphenous nerve.

Middle cutaneous.—The nerve for the centre of the front of the thigh is a cutaneous offset from the anterior crural, and divides into two branches that may pierce the fascia at separate spots. It is transmitted through the fascia lata about three inches from Poupart's ligament, and its branches are continued to the knee, where it communicates with the offset of the great saphenous nerve over the patella. In the superficial fascia this nerve is united with the genito-crural and internal cutaneous nerves. In some instances the nerve is inclined to the inner side of the knee, and is substituted for a branch (anterior) of the following nerve.

Middle cutaneous is on front of the thigh, and reaches the knee.

Internal cutaneous.—Derived from the anterior crural trunk, like the preceding, this nerve is furnished to all the inner side of the thigh. It is divided into two branches (anterior and inner), that perforate the fascia in separate places.

Internal cutaneous is divided into two.

a. The *anterior* branch becomes cutaneous in the lower third of the thigh in the line of the inner intermuscular septum, along or somewhat behind which it is continued to the knee. This branch is distributed in the integument of the lower third of the thigh at the inner part, as well as in that over the patella and the inner side of the knee joint, and is united with the branch of the internal saphenous nerve. Occasionally this part of the nerve is found below the level of the knee joint; and in that case it is larger than usual, and is joined by a small offset from the saphenous nerve.

The anterior branch extends to knee along the septum.

b. The *inner* branch perforates the fascia at the inner side of the knee behind the internal saphenous nerve, with which it communicates; it furnishes offsets to the lower part of the thigh, and the upper half of the leg on the inner surface.

The inner ends in upper part of the leg.

Other small cutaneous branches for the supply of the inner side of the thigh arise from either the trunk, or the two final branches of the internal cutaneous nerve, and appear by the side of the saphenous vein, after piercing the fascia lata. One or two come into view near the upper part of the vein, and reach as far as the middle of the thigh; and one, of larger size than the rest, appears where the others cease, and extends as far as the knee. These cutaneous offsets usually communicate.

Other small twigs to inner part of the thigh.

Internal saphenous.—A branch of the anterior crural, like the two preceding, this nerve is continued to the foot, but only a little part of it is now visible. The nerve pierces the fascia on the inner side of the knee, and, after communicating with the inner branch of the internal cutaneous, gives forwards some offsets over the knee joint; finally it accompanies the saphenous vein to the leg and foot.

Internal saphenous appears by the knee and passes to the leg.

One branch of the saphenous nerve (*patellar*) appears on the surface of the fascia, higher than the trunk from which it springs. It is soon joined by the internal cutaneous nerve, and ends in many

A branch from it over the patella

branches over the patella; its ramifications communicate with offsets from the external and middle cutaneous, and the trunk of the saphenous nerve, and form an interlacement (*plexus patellæ*) over the joint. When this branch is small its place is taken by the internal cutaneous nerve.

forms a plexus with others.

Clean the surface of the fascia lata,

Dissection. — Let the fat and the inguinal glands be now removed from the surface of the fascia lata, without however destroying the cutaneous nerves. At the upper part of the thigh the student is to define the inner margin of the saphenous opening, by detaching the superficial fascia. The outer border is blended with the subjacent crural sheath as well as with the superficial fascia; but it is only after the uniting fibrous bands are broken or cut through, that the outer semilunar margin of the saphenous opening comes into view, and the student must not expect to find it so defined as it is represented in drawings.

and define saphenous opening.

Fascia lata surrounds limb;

The *fascia lata* is the deep aponeurosis of the thigh. It surrounds the limb, giving a firm sheath to it, and sends inwards septa between the different muscles. This membranous investment is of a bluish white colour, and very variable thickness, though it is always stronger on the outer than on the inner aspect of the limb, in consequence of the insertion into it of the tensor vaginæ femoris and gluteus maximus muscles. In fat bodies it is sometimes so slight as to be taken away with the superficial fascia.

strength varies.

Apertures in it.

Numerous apertures exist in the fascia for the transmission of the cutaneous nerves and vessels, and the largest of these is near Poupart's ligament, for the passage of the internal saphenous vein. The processes prolonged from the under surface form septa between, and fibrous sheaths for the several muscles. Some of these are larger than the rest, and are named specially the intermuscular septa of the thigh: thus two, outer and inner, are fixed to the femur, so as to limit on the sides the extensors of the leg; and a third intervenes between the adductors and the flexors of the leg. The position of these partitions is marked on the surface by white lines.

Processes between the muscles.

Connected with bone at upper part of thigh.

At the upper part of the thigh the fascia is fixed to the prominent borders of the pelvis. Taking the circumference of the limb, the student will find the fascia connected externally with the iliac crest; in the middle line behind with

the lower end of the sacrum and the coccyx; internally with the pubes and the pubic arch; and in front with Poupart's ligament, between the pubes and the iliac crest. At the lower part of the thigh, behind the knee joint, it passes uninterruptedly to the leg; but in front of the articulation it is blended with an expansion from the extensor muscles, and is continued over the patella, though separated from the bone by a bursa, to be inserted into the heads of the tibia and fibula.

Difference at lower part.

Directions. — The flaps of skin that were removed from the front of the thigh, to follow the cutaneous vessels and nerves, are now to be replaced, and the saphenous opening is to be learnt.

Cover the fascia except above.

The *saphenous opening* in the fascia lata receives its appellation from transmitting the saphenous vein. This aperture is oval in form, and is situate rather to the inner side of the middle line of the thigh; it measures about half an inch in width and one inch and a half in length. Its upper extremity (superior cornu) is at Poupart's ligament; and its lower extremity (inferior cornu) is distant from that structure about one inch and a half, and presents a well defined margin.

Saphenous opening; situation, form, and size.

The inner side of the opening is posterior to the level of the femoral vessels; it is deficient above in a prominent edge, for the fascia constructing it is stretched over a flat subjacent muscle (pectineus), but it is marked below by a firm and sharp border. The outer boundary is much stronger, and has, when detached, a semilunar border, whose concavity is turned downwards and inwards: this is named from its shape, *falciform* border or margin of the saphenous opening (falciform process of Burns); it is superficial to the femoral vessels, and is connected by fibrous bands to the crural sheath, and to the deep layer of the superficial fascia. If the outer edge be traced upwards, it will be found to arch to the inner side of the femoral vein, and to blend with the base of Gimbernat's ligament (part of the insertion of Poupart's ligament): the upper end of this border, where it is internal to the vessels, has been known as the *femoral* ligament.

Inner margin is not sharp; outer is firm and semilunar, and arches to join Gimbernat's ligament.

The rigidity of the margin of the saphenous opening is much influenced by the position of the limb; for if the finger be placed beneath the upper part of the falciform border,

Tenseness of the margins depends

on the position of the limb. whilst the limb is moved in different directions, the dissector will perceive that this band is most unyielding when the limb is extended and rotated outwards, and most relaxed when the thigh is flexed and turned in the opposite direction.

Parts transmitted through the opening. Through the lower part of the opening the saphenous vein, and the ducts of the inguinal glands are transmitted: and through the upper part, close to the falciform edge, a femoral hernia would project.

Nomenclature of the fascia at the top of the thigh. Sometimes terms are applied to the fascia on opposite sides of the saphenous opening, as if there was a distinct piece in each spot; thus the piece on the outer side of the opening is called iliac part of the fascia lata, from its attachment to the iliac crest; whilst that on the inner side, which is fixed to the pubes, is named in like manner the pubic part of the fascia lata.

Anatomy of parts concerned in a femoral hernia. Parts concerned in Femoral Hernia. — Besides the saphenous opening, the dissector has to study the under-mentioned parts, to obtain a knowledge of the structures amongst which the hernial protrusion is situate; viz. the crural arch and Gimbernat's ligament, the crural sheath, the crural canal and the crural ring, together with a membranous partition (septum crurale) between the thigh and the abdomen.

Dissection to see a sheath around femoral vessels. *Dissection.* — To examine Poupart's ligament and a loose sheath of membrane that surrounds the femoral vessels, the piece of the fascia lata outside the saphenous opening is to be reflected by the following incisions. One cut may be begun near the edge of the falciform border, and be carried outwards for one inch and a half, parallel and close to Poupart's ligament; another is to be directed obliquely downwards from the termination of the first, towards and a little below the inferior cornu of the opening. When the fascia has been turned inwards and some fat removed, the tube of membrane (crural sheath) will be brought into view as it descends beneath Poupart's ligament.

Define sheath. With the handle of the scalpel the sheath is to be separated carefully from the fascia lata beneath, and from the ligament in front of it; and Gimbernat's ligament on the inner side of the sheath, to which the upper end of the falciform border is united, is to be defined.

The crural *Poupart's ligament,* or the crural arch, is a firm band, de-

rived from the aponeurosis of the external oblique muscle of the abdomen, which stretches from the front of the iliac crest to the pubes (p. 475.). When viewed on the surface, the arch has not a straight direction between its bony attachments, as long as the fascia lata is entire, but is curved downwards towards the thigh. Its outer half is oblique; but its inner half is almost horizontal, and widens as it approaches the pubes, where it is inserted into the spine, as well as into the pectineal line of the hip bone for about an inch, forming Gimbernat's ligament. The space beneath the crural arch, between it and the innominate bone, is closed by the parts passing from the abdomen to the thigh, and is larger in the female than in the male. The outer half of the interval is filled by the fleshy psoas and iliacus muscles, to which the arch is so closely bound by fascia, as commonly to prevent any protrusion of intestine at this spot; and the inner half of the space is occupied by the femoral vessels and their sheath.

arch; attachments; form; parts closing hollow beneath.

Gimbernat's ligament. — The structure that has received the name of Gimbernat's ligament, is the part of the tendon of the external oblique muscle of the abdomen that is inserted into the pectineal line of the hip bone (p. 475.). It is only a portion of the attachment of the crural arch to the bone; but when Poupart's ligament is in its natural position, and the structure is looked at from below, this piece of the tendon appears triangular in form, with its base directed outwards. Viewing it as a separate structure, it is about one inch in length. Its apex is at the pubic spine; whilst its base is in contact with the crural sheath, and is blended with the fascia lata, — the part that forms the outer margin of the saphenous opening. By one margin (anterior) it is continuous with the crural arch, and by the opposite it is fixed to the pectineal line. In the erect position of the body the ligament is almost horizontal, and one surface is directed upwards to the abdominal cavity, whilst the other is turned towards the thigh. On forcibly raising the crural arch, the continuation of Gimbernat's ligament with that band will plainly appear.

Gimbernat's ligament is part of the insertion of Poupart's. Form, situation, and connections.

The *crural sheath* is a loose tube of membrane around the femoral vessels. It has the form of a funnel which is sloped unequally on the sides: the wide part or base of the tube is

Crural sheath. Shape

and connections; turned upwards; and the narrow part ceases about two inches below Poupart's ligament, by blending with the common areolar sheath of the bloodvessels. Its outer border is nearly straight, and is perforated by the genito-crural nerve. Its inner border is oblique, and is pierced by the lymphatics and the saphenous vein; this part of the sheath appears in the saphenous opening, and is connected to the falciform margin and the superficial fascia. In front of the crural sheath and behind it is the fascia lata of the thigh. This tube of membrane is continuous with the fasciæ lining the abdomen in this way; the anterior part is prolonged beneath Poupart's ligament into the fascia transversalis, and the posterior half is continued into the fascia iliaca (p. 497.).

how formed.

Deep crural arch. Crossing the front of the crural sheath below the arch of Poupart's ligament, is a thickened fibrous band, which has been named the *deep crural* arch. This band is supposed to occasion sometimes the stricture of the subjacent intestine in a femoral hernia. A notice of it is given with the description of the fascia transversalis (p. 485.).

Open the crural sheath. *Dissection.* — The student may open the sheath by an incision across the front, and raise the loose anterior part with hooks. A piece of the areolar investment of the femoral vessels is to be cut out over the situation of both the artery and the vein. When this has been done two thin partitions may be defined; one is on the inner side of the vein separating it from a gland, the other is between the vein and the artery. A fatty stratum may be seen over the upper aperture of the sheath, closing the tube towards the abdomen.

Contents of the sheath. The *interior* of the *crural sheath* is occupied by the femoral vessels, and is divided into three compartments by two partitions. The position of those septa has been before referred to, — one being internal to the femoral vein, and the other between the two large vessels. In the outer compartment is the femoral artery, lying close to the side of the sheath; in the middle one is the femoral vein; and in the inner one (crural canal) is only a lymphatic gland. The femoral vessels are surrounded by a common covering of areolar tissue, which is distinct from the crural sheath now described.

Space divided into three parts.

Crural canal. — This term is applied to the innermost space in the interior of the crural sheath. Its extent is from a quarter to half an inch, for it reaches only from the base of Gimbernat's ligament to the upper cornu of the saphenous opening. Anterior to the sheath at this part, and consequently to the space, are Poupart's ligament and the upper end of the falciform margin of the saphenous opening; whilst behind it is the pectineus muscle, covered by fascia lata. On the outer side is the femoral vein. The aperture by which it communicates above with the cavity of the abdomen is named the crural ring. Through this canal or space the intestine in femoral hernia passes from the abdomen.

The inner of the three spaces is the crural canal

Extent and parts around it.

Some writers apply the term crural canal to the whole of the space included in the funnel-shaped sheath, and describe therefore the femoral vessels as being in the crural canal; but the appellation crural canal is here confined, as above stated, to the space in the sheath internal to the vessels.

Definition of term crural canal here employed.

The *crural* or *femoral ring* is the upper opening of the crural canal towards the abdominal cavity.* It is on a level with the base of Gimbernat's ligament, and is larger in the female than in the male. It is oval in shape; and its greatest measurement is from side to side, in which direction it equals about half an inch. The structures that surround the opening, outside the crural sheath, are nearly similar to those bounding the crural canal, viz. in front the crural arch with the spermatic cord in the male, and the round ligament in the female; behind, the pubes covered by fascia lata; on the inside Gimbernat's ligament; and on the outside the femoral vein within the sheath. The position of the several sides of the ring is stated at p. 498.

Crural ring.

Situation and form.

Structures around.

Septum crurale. — The part of the subperitoneal layer of fat, which is placed over the opening of the crural ring, has been named crural septum (Cloquet) from its position between the thigh and the abdomen. The situation of the partition is now visible, but its characters are ascertained in the dissection of the abdomen (p. 497.).

Crural septum;

position

how formed.

* Gimbernat used the name crural ring, and Mr. Lawrence proposes to call it femoral aperture. Might not the nomenclature employed be made more to resemble that used in describing inguinal hernia, by calling this the internal crural aperture, and the saphenous opening the external crural aperture?

Femoral hernia.

Definition.

Femoral Hernia. — This kind of hernia consists in a protrusion of the intestine into the thigh beneath Poupart's ligament. In this affection the gut descends always in the crural sheath, and commonly on the inner side of the vein, though occasionally it may be situate on the outer side of the artery.

Course; first vertical, next directed forwards, and then upwards.

Course. — At first the intestine takes a vertical direction in its progress from the abdomen to the surface of the body, and passes through the crural ring, and along the crural canal as far as the saphenous opening. At this spot it changes its course, and is directed forwards; and should the gut protrude still farther the hernia again alters its direction and ascends towards the abdomen, in consequence of the ascent being easier than the descent on the front of the thigh. The winding course of the hernia must suggest to the dissector the direction in which attempts should be made to replace the intestine in the abdominal cavity. With the view of making the bowel retrace its course, it will be necessary first to press it down towards the saphenous opening, and afterwards backwards and upwards towards the crural canal and ring. The previous dissection will have demonstrated the necessity of raising the limb, and rotating it inwards during the manipulation to return the displaced intestine to its cavity, in order that the margin of the saphenous opening, and the other tissues may be relaxed.

By what means it is to be pushed back.

Coverings for the gut from the peritoneum, crural septum, crural sheath, cribriform fascia, fat and skin.

Coverings. — As the intestine takes the course above specified it is clothed by the following structures, which are elongated and pushed before it: they are here enumerated from within outwards, in the order in which they are received. First is a covering of the peritoneum lining the abdomen; next one from the crural septum across the crural ring; after this comes a stratum from the crural sheath, unless the hernia bursts through an aperture in the side; still farther out is a layer of the cribriform fascia; and, lastly, there is an investment of the superficial fat or fascia, together with the skin. From without inwards the order of the different strata will be reversed. The coverings may vary, or be conjoined in different degrees according to the condition of the hernia. In some instances, as above explained, the prolongation from the crural sheath is wanting; and in an old hernia the covering derived from the septum

The coverings may be altered.

crurale is usually united with that from the crural sheath, so as to form one layer, the *fascia propria* (Cooper). In general, in an operation for the relief of the strangulated bowel, the surgeon, after dividing the subcutaneous fat, can recognise but little of the coverings enumerated by anatomists until he meets with that of the subperitoneal fat or septum crurale.

The surgeon does not find so many as the anatomist.

Seat of stricture. —The strangulation of a femoral hernia may be situate either at the crural ring, or at the saphenous opening. If the constriction is at the latter spot and outside the neck of the sac, it will be removed by cutting through the upper part of the falciform margin of the saphenous opening, together with any other subjacent fibrous band which arches over the hernia. If it is deep in the neck of the sac, it will be relieved by opening the sac and making an incision into that structure, of a few lines in extent, with the knife directed horizontally inwards. The several vessels that may be wounded in attempting to relieve the deep stricture are enumerated at page 498.

Place of stricture.

How it is to be removed.

Supposing the sac opened.

Dissection. — The triangular space at the top of the thigh will be prepared by removing the fascia lata from the hollow near Poupart's ligament, and cleaning the parts that then come into view. The muscular boundaries on the sides may be first dissected; then the remains of the crural sheath are to be taken away, and the femoral vessels to be followed downwards as far as the sartorius muscle. On the outer side of the vessels the divisions of the anterior crural nerve are to be sought, together with the branches of an artery (profunda) which are buried in the fat. All the fat is to be cleared out of the space; and in removing it from beneath the femoral artery, the student is to look for one or two small nerves to the pectineus muscle.

Clean out Scarpa's triangular space.

The TRIANGULAR SPACE OF SCARPA is situate at the upper part of the thigh, and is beneath the hollow observable on the anterior aspect, near Poupart's ligament. It corresponds with the axillary space in the upper limb. Commonly its extent is somewhat less than that of the upper third of the thigh; but its length varies according to the breadth of the sartorius, and the height at which this muscle crosses inwards. The base of the space is at Poupart's ligament, and the apex at the meeting of the sartorius

Triangular space at top of the thigh;

extent;

boundaries.

with the adductor longus muscle. Bounding the hollow on the outer side are the conjoined psoas and iliacus, for about two inches, and below these is the sartorius; on the inner side are the pectineus and adductor longus muscles, and between and behind them near the femur, is a small part of the adductor brevis.

Contents. In this space are contained the femoral artery and vein, and the anterior crural nerve, and some of their branches, Femoral vessels, with a considerable quantity of fat. The femoral artery runs through the centre of the hollow, and supplies some small cutaneous branches, as well as a large deep offset, the and their branches. profunda: a small offset (superficial pudic) is directed from it to the pubes across the inner boundary. On the inner side of the artery is the vein which is here joined by the Anterior crural nerve. saphenous and profunda branches. Nearly half an inch external to the vessel is the large anterior crural nerve, which lies deeply at first between the iliacus and psoas, but afterwards becomes more superficial and divides into branches.

Femoral artery; FEMORAL ARTERY.— This vessel is a continuation of the external iliac artery of the abdomen, and retains the term femoral only for a given distance in the thigh. It reaches extent; from the lower border of Poupart's ligament to the margin of the opening in the adductor magnus muscle; and it occupies the front and the inner part of the thigh for only two-thirds of the length, for at the spot mentioned it turns course. backwards into the ham, and takes the name popliteal. The course of the vessel will be indicated, during rotation outwards of the limb, by a line drawn to the inner side of the internal condyle of the femur, from a point midway between Position to the femur. the symphysis pubis and the anterior iliac spine. In the upper part of its course the artery lies rather internal Division into two parts. to the head of the femur, and is comparatively superficial, being uncovered by muscle; but, in the lower part, it is placed along the inner side of the shaft of the femur, and is beneath the sartorius muscle. This difference in its connections allows of a division of the arterial trunk into two parts; viz. one in the upper, and one in the middle third of the thigh.

The upper part of The artery in the upper third of the thigh is contained chiefly in Scarpa's triangular space, where it is enveloped

by the crural sheath for about two inches, and is covered only by the skin and the superficial fascia, and by the fascia lata and some inguinal glands. At first the artery rests on the psoas muscle; and it is subsequently placed over the pectineus, though at some distance from it in this position of the limb, and is separated from it by fat, and by the profunda vessels and the femoral vein. Its companion vein and the anterior crural nerve have the following position with respect to it: — the femoral vein is on the inner side and close to it at the pubes, but lower down it is placed behind the artery; the anterior crural nerve is on the outer side, being distant nearly half an inch near Poupart's ligament, and some of the branches of the nerve approach the artery near the apex of the containing space.

the artery is superficial.

Parts behind it.

Position of vein and nerve.

The *branches* of this part of the artery are the superficial epigastric and circumflex iliac, two superficial pudic, and the deep femoral branch; the cutaneous offsets have been seen (p. 657.), with the exception of the following, which is beneath the fascia lata.

Branches of this part already seen, except

The inferior *superficial pudic* artery arises separately from, or in common with the other pudic branch (superior) (p. 657.). The course of this artery is inwards over the pectineus muscle to the scrotum or the labium pudendi, according to the sex: it perforates the fascia lata at the inner border of the thigh to reach its place of destination. In the integument it anastomoses with branches of the superficial perinæal artery.

one superficial pudic, which is beneath the fascia,

The *deep femoral* branch, or the *profunda*, is the largest offset of the femoral artery*, and arises from the outer part of that vessel, one inch to two inches (Quain) below Poupart's ligament. This branch is consumed in the muscles of the thigh, and its distribution will be afterwards ascertained. In the present dissection it is seen to be placed over the iliacus muscle, where it gives the external circumflex artery to the outer part of the thigh; and then to be directed, with a large vein, beneath the trunks of the femoral vessels to the inner side of the limb.

and the profunda.

Origin and position in Scarpa's triangle.

* Some anatomists apply the term common femoral to the part of the vessel above the origin of the profunda, and give the names superficial and deep femoral to the nearly equal parts into which it divides.

Femoral vein: first inside the artery, afterwards outside it.

Femoral Vein. — The principal vein of the limb, whilst in the triangular space in the upper part of the thigh, has almost the same relative anatomy as the artery. Its position to the artery is not the same, however, throughout: for beneath Poupart's ligament it is on the inner side of that trunk, and on the same level, and is supported on the pubes between the psoas and pectineus muscles; but it soon winds beneath the artery, and appears on the outer side opposite the upper border of the adductor longus muscle. In this space the vein receives the internal saphenous and the deep femoral branches.

Peculiarities

Peculiarities in the vessels.—Change in position.—Four examples of transference of the femoral trunk from the front to the back of the thigh have been recorded. In those cases the artery passed from the pelvis through the great sacro-sciatic notch, and accompanied the great sciatic nerve to the popliteal space.

The common deviations from the condition of the vessels in the triangular space, refer to a change in their position, or to the unusual origin of the chief branch of the artery.

in the position of the vein, or the vein may be divided.

Position of the vein. — The position of the vein with respect to the artery may be altered: for the venous trunk may be placed on the inner side through all the triangular space; or it may be slit so as to present a large vein on each side of the artery for a greater or less extent, or one of the two veins may lie over the arterial tube.

Origin of profunda varies from Poupart's ligament to four inches below.

Origin of the profunda. — The profunda branch, though arising commonly from the femoral artery between one inch and two inches from Poupart's ligament, may approach nearer to the ligament until it arrives opposite that band, or may even go beyond, and be fixed to the external iliac artery (one example, Quain). But the branch may recede farther and farther from the ligament, till (as in one case, Quain) it leaves the parent trunk at the distance of four inches from the commencement; so that in applying a ligature to the femoral artery in the upper part of the thigh, the thread should be placed four inches below Poupart's ligament, in order that the spot chosen may be free from the disturbing influence of an occasional large offset.

Take the fascia from the front of the thigh.

Dissection. — To proceed with the deep dissection, the flaps of skin are to be thrown aside; and the fascia lata is to be cut along the middle line of the thigh and knee, and to be reflected to each side, nearly to the same extent as the skin. Over the knee joint the student will find the fascia united with the tendon of the extensor muscles of the leg, so

as to form lateral accessory ligamentous bands. The limb is to be retained in the same position as in the dissection of the other parts.

Follow out sartorius

In raising the inner piece of the membrane the narrow muscle (sartorius) that appears should be followed to its insertion into the tibia, and care should be taken of the small nerves along its inner border, viz.: the two branches of the internal cutaneous above; the great saphenous and its branch below; and a plexus between the saphenous, internal cutaneous, and obturator, at the middle of the thigh. The dissector is to avoid displacing the muscle whilst he is removing its sheath of fascia, or should fix it with stitches.

and preserve nerves in contact with it.

Dissect the adductors,

Internal to the sartorius are some strong muscles (adductors) that are inclined outwards: these are to be laid bare; and the student is to seek a branch of the obturator nerve to the plexus before mentioned, beneath the more superficial muscle (adductor longus), near where this touches the sartorius.

and clean the extensor muscles.

On the outer side of the sartorius are the large extensor muscles of the leg. For the dissection of these the knee is to be bent to make tense their fibres: and an expansion, below, from the tendon to the fascia lata and the knee joint is to be looked to. One little muscle at the upper and outer part of the thigh, tensor of the fascia lata, is to be cleaned; and a strip of the fascia, corresponding with its width, should be left along the outer aspect of the thigh: behind this slip, the investing membrane is to be divided by one or two transverse cuts, and to be followed backwards to its attachment to the lines on the femur.

Muscles on the front of the thigh.

Deep parts on the front of the thigh.—The muscles on the front of the thigh are the sartorius, and the extensor of the leg. Many muscles are combined in the extensor, viz. the rectus, vastus externus, and vastus internus and crureus. At the top of the thigh is the small tensor of the fascia lata.

Vessels.

A portion of the femoral vessel, viz. the lower half, lies amongst the muscles and supplies them with branches.

Nerves.

One large nerve, the anterior crural, furnishes offsets to

the muscles on the front of the thigh, and is to be learnt with them.

Sartorius; The SARTORIUS is the longest muscle in the body, and extends from the pelvis to the leg: it arches over the front of the thigh, passing from the outer to the inner side of the limb, and lies in a hollow between the extensors on the one side, and the adductors on the other. origin; It has a tendinous origin from the anterior upper iliac spinous process, and from about half the interval between this and the inferior process. course over the thigh; Its fibres constitute a thin, riband-like muscle, which ends in a tendon below the knee, and is *inserted* into the inner surface of the tibia, insertion. opposite to the tubercle as well as an inch below it, and about three quarters of an inch from the crest of the bone. The muscle is superficial throughout, and is perforated by some cutaneous nerves and vessels. Connections of the first or oblique part; Its upper part is oblique, and forms the outer boundary of the triangular space that contains the femoral artery; it rests on the iliacus, rectus, and adductor longus muscles, as well as on the anterior crural nerve and the femoral vessels. of the middle part; The middle part is vertical: it lies at first in a hollow between the vastus internus and the adductor muscles, this connection continuing as low as the opening for the femoral artery; but beyond that point, where it bounds the popliteal space at the inner side, the sartorius lies between the vastus and great adductor and the inner hamstring muscles. The femoral vessels and their accompanying nerves are concealed by this portion of the muscle. and of the lower part. The lower or tendinous part lies on the internal lateral ligament of the knee joint, superficial to the tendons of the gracilis and semitendinosus, and separated from them by a prolongation of their synovial bursa: from its upper border there is an aponeurotic expansion which joins, over the knee, that from the extensors; and from its lower border, another which blends with the fascia of the leg. Below the tendon the great saphenous nerve appears with an artery; and piercing it, is the branch of the same nerve.

Divide the sartorius, *Dissection.*—The sartorius is to be turned aside, or cut through if it is necessary, to follow the remaining part of the femoral artery. Beneath the muscle is an aponeurosis and dissect nerves between the adductor and extensor muscles; when this is divided the internal saphenous nerve, and a nerve to the

vastus internus muscle that sends an offset to the knee joint, will come into view. The plexus of nerves on the inner side of the thigh may now be more completely dissected. The femoral vessels and their branches are to be nicely cleaned. Where the femoral artery passes to the back of the limb its small anastomotic branch arises; this is to be pursued in the fibres of the vastus internus to the knee, and a branch of it is to be followed with the saphenous nerve. and vessels.

The *aponeurotic covering* of the femoral vessels exists where these are covered by the sartorius. It is formed of strong fibres, that are directed transversely between the vastus internus and the tendons of the adductor muscles. Inferiorly the membranous structure ceases at the opening in the adductor magnus by a defined border, beneath which the saphenous nerve and its artery escape. Aponeurosis over the femoral artery: ends below by a defined border.

Femoral artery in the middle of the thigh.—In the middle third the femoral artery is more deeply placed than in the upper third of the thigh. It is covered by the sartorius muscle and the subjacent aponeurosis, in addition to the integuments and the superficial and deep fasciæ; and it lies in a hollow, bounded on the one side by the vastus internus, and on the other by the adductor longus and adductor magnus, by which it is conducted to the opening in the last muscle. On the outer side of the artery and close to it, is the femoral vein; to the outer side also, is the internal saphenous nerve, which is beneath the aponeurosis before noticed, but is not contained within the areolar sheath of the vessels. Deep part of the femoral artery. Connections. Position of vein and saphenous nerve.

Branches.—Only one named branch, anastomotic, springs from this part of the artery, the other offsets belonging to the muscles. Branches.

The *anastomotic branch* (arter. anastomotica magna) arises close to the opening in the adductor muscle, and splits at once into two parts, superficial and deep. Anastomotic, which

a. The *superficial* offset continues with the saphenous nerve to the lower border of the sartorius, and, piercing the fascia lata, ramifies in the integument. *b.* The *deep* or anterior branch is concealed in the fibres of the vastus internus, and descends in them, in front of the tendon of the adductor magnus, to the inner side of the knee joint, where divides into a superficial and a deep branch.

it anastomoses with the articular branches of the popliteal and anterior tibial arteries. A branch passes outwards from it in the substance of the vastus; this forms an arch in front of the lower end of the femur with an offset of the external articular artery, and supplies the joint.

The two pieces of the anastomotic artery may be separate at their origin, and spring from distinct parts of the parent trunk.

Muscular branches.

Muscular branches.— The branches for the supply of the muscles leave the outer part of the femoral artery, and belong mostly to the sartorius and the vastus internus.

Femoral vein.

The *femoral vein*, in its connections with the parts around, and in its branches, corresponds closely with the femoral artery. Its position with respect to the artery is, as above said, external to, and in contact with it.

The femoral artery may be divided.

Peculiarities in the splitting of the artery.— Occasionally the femoral artery is split into two below the origin of the profunda. Four examples of this peculiarity have been met with, but, in all, the trunks were blended again into one above the opening in the adductor muscle.

The vein may be inside the artery; or split;

Position of the vein.— The femoral vein may change its position here, as in the upper part (p. 672.), being found on the inner side of the artery; or it may be divided into two trunks, which lie on the sides of its companion vessel.

or very small.

Size of the vein.— In some bodies this part of the femoral vein is very small in size, in consequence of the popliteal coursing along the back of the thigh to enter the profunda vein, instead of accompanying the main artery of the limb through the aperture in the adductor magnus.

To expose muscles on front of the femur.

Dissection.— The femoral artery and vein are to be cut across below the origin of the profunda, and to be thrown downwards, preparatory to the deeper dissection. After these are cut, all the fat and the small veins are to be carefully removed from amongst the branches of the profunda artery and the anterior crural nerve. By this step the upper part of the vastus internus and crureus muscles will be prepared for learning.

Tensor vaginæ femoris arises from pelvis,

The TENSOR VAGINÆ FEMORIS extends only along the upper third of the thigh, and is the smallest and the most external of the outer set of muscles. It takes *origin* from the front of the crest of the hip bone at the outer aspect, from the anterior upper iliac spine, and from the part of the

notch between this and the inferior spine, as far as the attachment of the sartorius. Its fibres form a fleshy belly about two inches wide, and are *inserted* into the fascia lata about three inches below the great trochanter of the femur, and rather in front of it. At its origin the muscle is situate between the sartorius and the gluteus medius. Beneath it are the ascending branches of the external circumflex artery, and a branch of the superior gluteal nerve that enters it at the under aspect. A strong sheath of fascia surrounds the muscle.

ends in fascia lata.

Parts around.

Dissection.—After the muscle has been learnt, the slip of fascia extending from it to the knee may be cut through; and the tensor of the fascia lata being detached from the muscles around, the head of the rectus muscle may be followed to the pelvis.

Cut through the last muscle.

The TRICEPS EXTENSOR of the leg consists of three parts, which may be described as three muscles with a common insertion, viz. rectus, vastus externus, and vastus internus and crureus. Or, like the extensor of the arm, the muscle may be considered single below and attached by a common tendon; but divided into three heads above, which are inserted into separate points of bone.

Outline of muscles on front of thigh.

The RECTUS FEMORIS forms a fleshy prominence on the front of the thigh, and reaches from the pelvis to the common insertion. At its *origin* from the pelvis the muscle has two tendinous processes or heads:—one arises from the anterior inferior iliac spinous process; the other (to be afterwards seen) is fixed into a depression on the back of the hip bone, close above the brim of the acetabulum. Fleshy fibres succeed to tendon; and they end inferiorly in another tendon, which joins the tendinous parts of the muscles beneath, and is *inserted* with them into the head of the tibia. The rectus is larger at the middle than at the ends; and its fibres are directed from the centre to the sides, like the feather of a quill, giving rise to that condition called penniform. It is subcutaneous, except above where it is overlaid by the sartorius; but it conceals branches of the external circumflex artery and the anterior crural nerve, and rests on the muscular mass of the vastus and crureus. The upper tendon of the muscle reaches farthest on the anterior surface, where the sartorius lies on it; whilst the lower

Rectus has an origin at the pelvis, which is double,

and an insertion into the head of the tibia.

The muscle is penniform, and superficial, except above.

tendon is most extensive on the posterior aspect, or towards the subjacent muscles.

Cut the rectus,

Dissection. — To see the remaining muscles, cut across the rectus near its lower end, and raise it without injuring the branches of vessels and nerves beneath it. The muscular mass on the front of the femur is to be divided into two along the situation of some descending vessels and nerves. The muscle external to those vessels is the vastus externus, and the larger mass, internal to them, is composed of the vastus internus and crureus: the last two muscles are inseparably united, but if the student wishes to make two distinct parts, he may carry the scalpel through the fibres in a line with the inner border of the patella.

and separate the extensor muscles.

Vastus externus

The VASTUS EXTERNUS is one of the parts of the strong extensor muscle of the leg, and its attachment to the femur is very narrow in comparison with its size and thickness. It has a lengthened *origin* externally, which is, for the most part, from a quarter to half an inch thick. Thus, beginning above, it arises from the root of the neck of the femur; from the fore part and the outer surface of the root of the great trochanter; from the line connecting the trochanter with the linea aspera; from the outer margin of the linea aspera; from two-thirds of the line extending downwards to the outer condyle; and, lastly, from the external intermuscular septum. Inferiorly the fibres of the muscle end in an aponeurosis; and this blends with the tendons of the rectus and vastus internus to form a common tendon. The muscle is pointed at the upper part, but enlarged below, where it produces the prominence on the outer side of the thigh. Its cutaneous surface is aponeurotic at the upper part, and is covered by the rectus, tensor vaginæ femoris, and gluteus muscles; but the deep surface rests on the vastus internus and crureus, and on branches of the external circumflex artery and anterior crural nerve.

is thin at the origin;

but is thicker below, at its insertion.

Parts in contact with the surfaces.

Vastus internus and crureus.

The VASTUS INTERNUS and CRUREUS are inseparably united, and will be here described as one muscle. The fleshy mass arises from the anterior and lateral surfaces of the femur, except at the ends, and its limits may be thus indicated: — It reaches upwards as far as the anterior intertrochanteric line; downwards, to about two inches from the articular end of the femur; outwards, to the vastus externus; and

One mass on the front of the femur.

Its origin;

inwards, to the internal margin of the linea aspera as well as the lines continued from it towards the ends of the bone, viz. to the anterior intertrochanteric line in one direction, and the inner condyle of the femur in the opposite direction. At the lower end of the muscle the fibres terminate in a cutaneous aponeurosis that blends in the common tendon of insertion. The upper part of the muscular mass is buried beneath the sartorius and rectus muscles; but the lower part is superficial, and projects more than the vastus externus at the opposite side of the thigh. The adductor muscles are almost inseparably joined with this vastus along its attachment to the linea aspera.

insertion by a common tendon.

Upper part is deep, but the lower is superficial.

Dissection.—The common tendon of the vasti and rectus can be demonstrated, after the expansion from it over the knee joint is divided along the middle of the patella to the head of the tibia. By reflecting inwards and outwards that thin prolongation the tendon will be laid bare. A strong transverse band will be likewise seen on each side of the patella; the outer of the two is the strongest.

Lay bare the common tendon of the extensors.

The *tendon* of the *extensor muscles* of the leg is common as before said, to the rectus, the vastus externus, and the united vastus internus and crureus. Its position is in front of the knee joint, to which it serves the office of an anterior ligament. Wide above where the muscular fibres terminate, it narrows as it descends over the joint, and is inserted inferiorly into the prominence of the tubercle of the tibia and into the bone below it for an inch. Close to its attachment to the tibia a synovial bursa is beneath it; and in its fibres the patella is situate, like a sesamoid bone in other situations. (See Ligament of the Patella.) From the upper part of the tendon an aponeurotic expansion is derived: this prolongation, which is strongest on the inner side, is united with the fascia lata and the other tendinous offsets to form a capsule around the joint, and is fixed below to the heads of the tibia and fibula.

Tendon of the extensors;

attachments;

bursa beneath.

Expansion from it.

Subcrureus muscle.—Beneath the united vastus and crureus, near the knee joint, is a thin subcrural band of pale fibres. It is but a part of the muscle on the front of the femur, which is separated from the rest of the fibres by a layer of connective tissue. Attached therefore to the front of the femur in its lower fourth, it ends in aponeurotic

Small subcrureus muscle;

ends on the sac

of the joint. fibres on the outer surface of the synovial sac of the knee joint.

Inter-muscular septa are two: *Intermuscular septa.*—The processes of the fascia lata that limit laterally the extensor muscles of the leg, are thus named, and are fixed to the linea aspera, and the lines leading from it to the condyles of the femur.

the outer is the strongest; The *external* septum is the strongest, and reaches from the outer condyle of the femur to the insertion of the gluteus maximus. It is situate between the vastus externus and the short head of the biceps, to which it gives origin; and is perforated near the outer condyle by the upper external articular vessels. the inner is indistinct. The *inner* partition is very thin along the side of the vastus internus; and, between the inner condyle and the linea aspera, its place is supplied by the strong tendon of the adductor magnus. The internal articular vessels are transmitted through it to the front of the knee joint.

Artery to the muscles on the front of the thigh. The *external circumflex artery* is the chief vessel for the supply of the muscles of the front of the thigh. It arises from the outer side of the profunda (deep femoral) artery, and is directed horizontally outwards through the divisions of the anterior crural nerve, and beneath the sartorius and rectus muscles, to the under surface of the vastus externus, where it ends in branches. Its branches are— Offsets are given from this artery to the rectus and the sartorius; and its terminal branches consist of an ascending, a transverse, and a descending set.

an ascending set, *a.* The *ascending branches* are about three in number, and are directed beneath the tensor vaginæ femoris to the back of the hip bone, where they anastomose with the gluteal artery.

a transverse, *b.* The *transverse* or middle set, the least numerous and the smallest in size, perforate the vastus externus, and anastomose on the back of the thigh with the sciatic and perforating arteries.

and a descending set. *c.* The *descending branches* are the largest, and are distributed to the vasti muscles. One considerable offset enters the vastus externus, and reaching the knee, anastomoses on it with the external articular arteries.

Varieties in the trunk and *Peculiarities in the origin* of this artery are very frequent. Thus the vessel may arise as one trunk from the superficial instead of the deep femoral artery. It may be represented by two pieces, which

may spring from either of the two femoral trunks: or these may be derived from both trunks — one piece being obtained from each: this last arrangement is most frequently found. branches.

The ANTERIOR CRURAL NERVE is derived from the lumbar plexus (p. 584.), and supplies the muscles and the integument of the front of the thigh, and the integument of the inner side of the leg. Soon after the trunk of the nerve leaves the abdomen it is flattened, and is divided into a superficial or cutaneous, and a deep or muscular part. Nerve of the front of the thigh is divided.

A. The *superficial* part of the nerve ends in these three branches: the internal and the middle cutaneous of the thigh, and the great saphenous. From its superficial part arise —

The *middle cutaneous nerve* perforates the fascia lata, sometimes also the sartorius, about three inches below Poupart's ligament, and extends on the surface of the thigh to the knee. Its cutaneous distribution is described at page 661. middle cutaneous;

The *internal cutaneous nerve* sends two or more small twigs through the fascia lata to the integument of the upper third of the thigh, and then divides in front of the femoral artery, or on the inner side, into the two following branches, anterior and inner.* Sometimes these branches, in which the nerve ordinarily ends, arise from the anterior crural trunk at separate spots. internal cutaneous; which has

The *anterior* branch is directed to the inner side of the knee joint. As far as the middle of the thigh it lies over the sartorius, but it then pierces the fascia lata, and ramifies in the integument as before said (p. 661.). anterior and

The *inner* branch is distributed in the integument of the inner side of the leg, just below the knee, but it remains beneath the fascia lata as far as the knee (p. 661.). Whilst underneath the fascia the nerve lies along the inner border of the sartorius, and joins in a plexus, about the middle of the thigh, with offsets of the obturator and internal saphenous nerves. When this branch is small it ends in the plexus just mentioned, and in twigs to the inner part of the thigh, instead of being continued onwards to the leg. inner branch.

The *internal saphenous* nerve is the largest of the three superficial branches; it becomes cutaneous on the inner side of the knee, and accompanies the vein of the same name to Internal saphenous nerve

* This is the arrangement that is most commonly met with. — See foot note to the Second Edition, p. 624.

the foot (p. 661.). In the thigh the nerve takes the course of the deep bloodvessels: thus it approaches the femoral artery where this is concealed by the sartorius, and is continued along the outer side of that vessel, beneath the aponeurosis covering the same, as far as the opening in the adductor magnus muscle. At that spot the nerve passes from beneath the aponeurosis, and is continued under the sartorius muscle to the upper part of the leg, to become cutaneous as before said. It supplies two cutaneous offsets whilst it is contained in the thigh beneath the fascia.

becomes cutaneous at the knee;

One of these offsets (*communicating branch*) arises about the middle of the thigh, and crosses inwards, beneath the sartorius, to join the internal cutaneous and the obturator in the plexus: this branch is sometimes absent. The other *branch* to the *front* of the *patella* springs from the nerve near the knee joint, and perforating the sartorius muscle and the fascia lata, ends in the integument over the knee (p. 661.).

has a communicating and a patellar offset.

B. The *deep* or *muscular* part of the anterior crural nerve gives branches to all the muscles of the front of the thigh, except the tensor vaginæ femoris; and supplies also an offset to one of the adductor muscles, viz. the pectineus.

From the deep part arise

Two slender *nerves* cross beneath the femoral artery, and enter the anterior surface of the *pectineus*.

branches to pectineus,

Branches to the *sartorius* are furnished by the middle or by the internal cutaneous nerve, whilst it is in contact with that muscle.

sartorius,

A *nerve* enters the under surface of the *rectus* muscle at the upper part, and divides into branches as it is about to penetrate the fibres.

rectus,

The *nerve* to the *vastus externus* separates into two or more branches as it enters the muscle. From one of these an *articular* filament is continued downwards to the knee joint, which it enters on the anterior aspect.

vastus externus and knee joint,

The *nerve* to the *vastus internus* is nearly as large in size as the internal saphenous, in common with which it often arises. To the upper part of the muscle it furnishes one or more branches, and is then continued beneath the aponeurosis covering the femoral vessels as far as the centre of the thigh, where it ends in offsets to the muscle and the knee joint.

and vastus internus.

The *articular* branch is prolonged to the inner side of the knee joint on or in the vastus, and on the tendon of the adductor mag-

Its articular

nus, and is distributed over the synovial membrane of the front of the articulation: this small nerve accompanies the deep branch of the anastomotic artery. branch to knee.

A *branch* of nerve to the *tensor vaginæ femoris* is derived from the superior gluteal (p. 697.), and enters the under surface of the muscle. In the fibres it extends nearly to the lower end. Nerve of tensor vaginæ.

Directions. — After the examination of the muscles of the front of the thigh with the vessels and nerves that are furnished to them, the student is next to learn the adductor muscles and their vessels and nerves. Take next the adductors.

Dissection. — To prepare the muscles, the investing tissue is to be taken from them, and the superficial adductors are to be separated one from another. Let the student be careful of the branches of the obturator nerve in connection with the muscles, viz. those offsets entering the muscular fibres, and the plexus on the inner side of the thigh. Lastly, should any fat and veins be left with the profunda and its branches, the whole must be cleared away. Dissection of adductor muscles.

DEEP PARTS ON THE INNER SIDE OF THE THIGH.

The muscles in this position are the three adductors, longus, brevis, and magnus, with the gracilis and the pectineus; these have the under-mentioned position with respect to one another. Internal to all and the longest, is the gracilis. Superficial to the others, are the pectineus and the adductor longus; and beneath those two are the short adductor and the adductor magnus. The adductor muscles and their position.

In connection with these muscles, and supplying them, are the profunda artery (of the femoral) and its branches, with the accompanying vein. Vessels.

The obturator nerve lies amongst the adductor muscles, and furnishes branches to them. Nerve.

The GRACILIS reaches from the pelvis to the tibia, and is fleshy and riband-like above, but tendinous below. The muscle *arises* by an aponeurosis, two or three inches in depth, from the lower or pubic border of the hip bone close to the margin, viz. opposite the lower half of the symphysis, and the upper part of the pubic arch close to the inner margin. Inferiorly it is *inserted* by a flat tendon, about half Gracilis takes origin from the pelvis, is inserted

into tibia. an inch wide, into the inner surface of the tibia, beneath and close to the sartorius. The muscle is superficial throughout. At the upper part of the thigh it is flattened against the adductors brevis and magnus, so as to have its borders directed forwards and backwards; and in the lower third it intervenes between the sartorius and semimembranosus muscles, and forms part of the inner boundary of the popliteal space. Its tendon, at the insertion, is nearer the knee than that of the semitendinosus, though at the same depth, and both lie over the internal lateral ligament; an expansion is continued from it to the fascia of the leg, as in the tendon of the sartorius. A bursa separates it from the ligament of the joint, and projects above it to the sartorius tendon.

Position to other muscles.

Pectineus. The PECTINEUS is the highest of the muscles directed from the pelvis to the inner side of the femur. It has a fleshy origin from the ilio-pectineal line of the hip bone, and from the triangular smooth surface in front of that line; and it is *inserted* inferiorly by a tendon, about two inches in width, into the femur behind the small trochanter, and into the upper part of the line which extends from that process to the linea aspera. The muscle is twisted, so that the surfaces which are directed forwards and backwards near the pelvis, are turned inwards and outwards at the femur. One surface is in contact with the fascia lata; and the opposite touches the obturator muscle and nerve, and the adductor brevis. The pectineus lies between the psoas and the adductor longus; and the internal circumflex vessels pass between its outer border and the former muscle.

Origin from pubes, inserted into femur. Muscle is twisted. Surfaces. Parts on the sides.

Adductor longus extends from pelvis to femur. The ADDUCTOR LONGUS lies below the pectineus, and is triangular in form, with the apex at the pelvis and the base at the femur. It *arises* by a narrow tendon from the front of the pubes near the angle of union of the crest and the symphysis, and is *inserted* along the middle third of the shaft of the femur—into the inner margin of the linea aspera. This muscle is situate between the gracilis and the pectineus, and forms part of the inner boundary of the triangular space containing the femoral vessels. Its anterior surface is covered near the femur by the femoral vessels and the sartorius; and the posterior rests on the other two adductors, on part of the obturator nerve, and on the deep

Its connections with muscles and vessels.

femoral artery. Aponeurotic bands connect the tendon of the muscle at its insertion with the tendons of the adductor magnus and vastus internus.

Dissection. — Some of the deeper muscles, with the obturator nerve and the profunda vessels, will be arrived at by reflecting the two last muscles. Dissection of

On cutting through the pectineus near the pubes, and throwing it down, the dissector may occasionally find the small accessory nerve of the obturator which turns beneath the outer border; if this is present, its branches to the hip joint and the obturator nerve are to be traced out. The adductor longus is then to be divided near its origin, and raised with care, so as not to destroy the branches of the obturator nerve beneath; its tendon is also to be detached from that of the adductor magnus to see the branches of the profunda artery. Now, the adductor brevis will be laid bare; with a part of the obturator nerve crossing over it to enter the plexus at the inner side of the thigh, and with a deeper part of the same nerve beneath it; the muscle should be separated from the subjacent adductor magnus, where the lower branch of the nerve and an artery issue. In this last step of the dissection the student should seek a small articular branch of the obturator nerve, which descends on and in the fibres of the adductor magnus to the knee joint. obturator nerve and adductor brevis. Articular nerve to knee joint.

The *accessory obturator nerve** (Schmidt) is derived from the trunk of the obturator near the lumbar plexus (p. 585.), and passes from the abdomen over the brim of the pelvis. In the thigh this branch turns beneath the pectineus and joins the superficial part of the obturator nerve: at the same spot it supplies an offset to the under surface of the pectineus, and another to the hip joint with the articular artery. When the nerve is small, one or more of these offsets are wanting. Accessory obturator nerve is often absent.

The ADDUCTOR BREVIS has a thin fleshy and aponeurotic attachment about two inches in depth to the front of the hip bone with the gracilis. The muscle *arises* from the Adductor brevis is thin at the origin

* This small nerve is often absent; it was found only four or five times in nine or ten bodies which were examined by its discoverer. The name given to it by Schmidt refers to this irregularity, viz. nerv. ad obturatorem accessorius inconstans. — *Commentarius de Nervis Lumbalibus.*

pubic border of the bone close to and outside the gracilis; but it reaches upwards rather higher, viz. to the adductor longus, and not quite so low as the muscle with which it is conjoined. It is *inserted* behind the pectineus into the whole of the line leading from the linea aspera towards the small trochanter. In front of the muscle are the pectineus and the adductor longus; but it is gradually uncovered by the latter below, and the contiguous borders of the two are side by side at their insertion into the femur: on this aspect, too, are the superficial piece of the obturator nerve, and the profunda artery. Behind the muscle is the adductor magnus, with the deep piece of the obturator nerve. In contact with the upper border is the obturator externus, and the internal circumflex artery passes between the two.

and wide at the insertion. Parts in front, behind, and at upper border.

The OBTURATOR NERVE is a branch of the lumbar plexus (p. 585.), and supplies the adductor muscles of the thigh, as well as the hip and knee joints. The nerve issues from the pelvis through the aperture in the upper part of the thyroid foramen; and it divides in that opening into two parts, which are named superficial and deep from their position with respect to the adductor brevis muscle.

Obturator nerve is divided into two:

The *anterior* or *superficial* part of the nerve joins the plexus of the internal cutaneous and saphenous nerves at the inner aspect of the thigh (p. 681.). The nerve is directed over the adductor brevis, but beneath the pectineus and the adductor longus. At the lower border of the last muscle it furnishes an offset to join in the interlacement of the nerves, but the remainder of it is continued to the femoral artery, on which it is distributed. In addition to the branches before mentioned, the nerve receives (sometimes) the communicating twig from its accessory branch, and supplies the hip joint, and some of the surrounding muscles.

the superficial part joins plexus in the thigh, ends on femoral artery.

Branches.— Near the pelvis or in the aperture of exit, this division of the nerve sends outwards an *articular* twig to the hip joint, with the artery to the same part. *Muscular* branches are furnished to the adductor longus, the adductor brevis, and the gracilis.

Branches are to hip joint. Muscular to some adductors.

Unusual condition of the nerve.— In some bodies this superficial division of the nerve is of large size, and extends beyond the plexus in the middle of the thigh. In such instances the nerve joins freely in the plexus, and gives cutaneous offsets to the integument

This part may be larger

of the thigh; but is afterwards continued along the inner border of the sartorius to the inner side of the knee, where it perforates the fascia to end in the integument: it has, in fact, a position and distribution similar to that of the inner branch of the internal cutaneous nerve (p. 681.), whose place it takes.

and extend to the inner side of the knee.

The *posterior* or *deep* part of the obturator nerve pierces the fibres of the external obturator muscle, and is continued beneath the adductor brevis to be distributed chiefly in the adductor magnus. Offsets are given from it to the contiguous muscles, and one to supply the knee joint.

Deep part of the nerve

Branches. — *Muscular* branches enter the obturator externus as the nerve pierces it; others belong to the large, and sometimes also to the short adductor. A slender *articular* branch enters the fibres of the adductor magnus towards the lower part, and passes through them, near the linea aspera, to reach the popliteal artery, by which it is conducted to the back of the knee joint: its termination is seen in the dissection of the popliteal space.

ends in adductor magnus, and gives branch to knee joint.

Dissection. — To prepare the profunda artery and its branches, supposing the veins and the fat removed, it will be requisite to follow backwards the internal circumflex artery above the upper border of the adductor brevis, and to trace the perforating branches through the tendons of the adductors near the femur.

Dissect profunda.

The PROFUNDA (deep femoral) is the chief muscular artery of the thigh, and arises from the femoral trunk about one inch and a half below Poupart's ligament (p. 671.). At its origin the vessel is placed on the outer side of the parent trunk. It is then directed inwards beneath the femoral vessels to the inner side of the femur. In this course it runs parallel to the femoral artery, but deeper in position, and ends at the lower third of the thigh in a small branch that pierces the adductor magnus. Where the vessel lies in the triangular space of the thigh (near its origin) it rests on the iliacus muscle, but on the inner side of the femur it is placed over the adductor brevis, and from that spot to its termination, between the adductors longus and magnus.

Profunda artery, origin, course, and ending.

Parts around.

Its *branches* are numerous to the surrounding muscles and the bone, and maintain free anastomoses with other vessels supplied to the upper part of the thigh, as well as with those of the leg. It is through these communications

Branches to muscles of the thigh join freely.

that the blood finds its way to the lower part of the limb when the tube of the chief artery is obliterated either above or below the origin of the profunda. The branches to the adductor muscles are unnamed. The named branches are these : — external circumflex to the extensor muscles of the knee ; internal circumflex round the inner side of the femur to the back of the thigh ; and perforating arteries through the adductors to the back of the limb and the extensor muscle of the knee.

The named branches are —

external circumflex;

The *external circumflex* artery has been described in the dissection of the muscles of the front of the thigh (p. 680.).

internal circumflex ;

ends on back of thigh,

supplies hip joint and muscles.

The *internal circumflex* branch arises from the inner and posterior part of the profunda, and turns backwards between the psoas and pectineus, but above the border of the adductor brevis, along the side of the tendon of the external obturator muscle. Having reached the back of the thigh, it ends in two branches, which will be seen in the dissection of the buttock. It supplies the under-mentioned branches to the inner side of the thigh : — An *articular* artery enters the hip joint through the notch in the acetabulum. At the border of the adductor brevis two *muscular* branches arise: one ascends to the obturator and the superficial adductor muscles; the other, which is larger, descends beneath the adductor brevis, and ends in this and the largest adductor.

Origin variable.

Peculiarities in origin. — The origin of the internal circumflex is very variable. In one body it may be from the femoral artery above the profunda ; in another from the external iliac artery, or from its branches — the epigastric and circumflex iliac.

Three perforating branches ;

second gives nutritious artery,

and the ending of profunda is a fourth.

The *perforating branches* are usually three in number, and pierce the tendons of some of the adductor muscles close to the linea aspera of the femur. The *first* is opposite the lower border of the pectineus, and perforates the short and large adductors. The *second* branch arises lower down, and passes through the same muscles as the preceding: from it a *nutritious* artery is supplied to the femur. The *third* artery springs from the deep femoral trunk below the adductor brevis, and is transmitted through the adductor magnus. The terminal branch of the profunda (fourth perforating) pierces the adductor magnus. These several arteries supply the muscles on the back and the outer part of the thigh ; and anastomose above with branches of the internal iliac, and below with those of the popliteal artery.

Profunda vein

The *profunda vein* results from the union of the different branches corresponding with those of its companion artery. It closely accompanies the artery of the same name, to which

it is superficial, being between this and the femoral vessels. Sometimes the vein is suddenly enlarged at the upper part by the union of a large trunk from the popliteal vein, which is directed upwards behind the adductor magnus, and then pierces this muscle. is sometimes joined by popliteal.

Dissection.—To bring into view the remaining muscles, viz. the adductor magnus, the obturator externus, and the insertion of the psoas and iliacus, the adductor brevis is to be cut through, and the investing layer of areolar tissue to be removed from each. After the adductor magnus has been learnt, it will be needful to detach a few of the upper fibres to examine the obturator externus. Cut through adductor brevis.

The ADDUCTOR MAGNUS is narrow at the pelvis, and wide at the femur: it is triangular in form, with the base directed upwards, whilst one side is attached to the femur and the other is free at the inner part of the thigh. Adductor magnus;

The muscle takes its origin from the part of the innominate bone corresponding with the subpubic arch, and extends from the lower border of the symphysis to the lower part of the ischial tuberosity. The fibres are directed to their attachment to the femur with different degrees of obliquity. Thus the upper fibres diverge from their origin, and construct almost a distinct part: they are horizontal above, but become more and more oblique below, and are *inserted* (from above down) into the lower end of the linea quadrati, and into the lower part of the line continued from the great trochanter to the linea aspera; into all the linea aspera; and into a small part of the line leading from that crest of bone to the inner condyle of the femur. Whilst the remaining fibres from the ischial tuberosity are vertical in direction, and end in a tendon about the lower third of the thigh; this tendon is inserted into the inner condyle of the femur, and is connected by a fibrous expansion to the line leading upwards from that point of the bone to the linea aspera. origin is narrow; fibres diverge to their insertion, some being horizontal, others vertical,

The muscle consists of the two parts above described, which differ in their characters. The upper one, thin and fleshy, forms a septum between the other adductors and the muscles on the back of the thigh; but the inner or lower piece, partly fleshy and partly tendinous, constitutes the inner thick margin of the muscle. On the anterior surface are the other two adductor muscles and the pectineus, with and form two different parts. Connections of the an-

terior and posterior surface; upper and lower borders; the obturator nerve and the profunda artery. The posterior surface is in connection with the hamstring muscles and the great sciatic nerve. In contact with the upper border are the obturator externus and the quadratus femoris, with the internal circumflex artery; and along the lower or inner border are the gracilis and the sartorius. At its attachment to the femur the muscle is closely united with the other adductors, particularly the adductor longus, and is there pierced by apertures for the passage of the femoral and perforating arteries.

and its insertion.

Opening for the vessels; The *opening* in the adductor for the transmission of the femoral vessels into the popliteal space is tendinous on the anterior, but fleshy at the posterior aspect. It is situate at the point of junction of the middle with the lower third of the thigh, and is larger than is necessary for the passage of the vessels. On the outside it is bounded by the vastus internus, but on the inside by the tendon of the adductor magnus, with some fibres added from that of the long adductor.

boundaries.

Psoas and iliacus in the thigh. The PSOAS and ILIACUS arise separately in the abdomen (p. 578.), but are united in the thigh. The conjoined crural portion of these muscles comes beneath Poupart's ligament, and descends to be *inserted* by a tendon into the small trochanter of the femur, as well as by fleshy fibres into a special triangular surface of the bone in front of and below that eminence. Beneath the ligament the muscles occupy the interval between the ilio-pectineal eminence and the anterior superior iliac spinous process. On the front of the psoas is the femoral artery, and between the two muscles lies the anterior crural nerve; whilst the fleshy mass covers the capsule of the hip joint and an intervening bursa. The pectineus and the internal circumflex artery are contiguous to the inner border; and the sartorius and vastus internus, to the outer edge of the muscles.

Insertion into femur.

Parts around.

Obturator externus; The OBTURATOR EXTERNUS is of a conical form, with the base at the pelvis and the apex at the femur. The fibres of the muscle take *origin* from the outer surface of the obturator membrane for the anterior two thirds; and from the bone bounding internally the thyroid foramen, the attachment being an inch wide opposite the symphysis pubis, but lower down only half that width. From that spot the fibres are

origin,

directed obliquely outwards and backwards to be *inserted* by a tendon into the pit at the root of the great trochanter. This muscle is concealed by the pectineus, adductor brevis, and adductor magnus; it is pierced by part of the obturator nerve, and covers the obturator membrane and artery. As it courses backwards it is in contact with the inner, and the lower part of the hip joint. The insertion of the muscle will be seen in the dissection of the buttock.

insertion. The adductors cover it, and it touches hip joint.

Dissection. — By detaching the obturator muscle in part from the pelvis, the branches of the artery and nerve of the same name will be seen amongst its fibres.

Detach obturator.

The *obturator artery* is a branch of the internal iliac in the pelvis (p. 609.), and enters the thigh through the upper part of the thyroid foramen; whilst in its aperture the artery divides into two parts, which inosculate, and form a circle around the obturator membrane beneath the muscle.

Obturator artery divides into two,

The *upper* branch extends along the inner half of the membrane, and anastomoses inferiorly with the other. The *lower* perforates the membrane beneath the upper branch, and turns downwards to form a circle by uniting with the preceding: this supplies an *articular* twig to the hip joint.

upper and lower branch; this gives articular twig.

Offsets of the obturator artery are furnished to the obturator muscles; and some small twigs extend even to the upper part of the adductors.

Muscular.

Branches of *nerve* to the muscle come from the deep division of the obturator trunk, and perforate the membrane with the lower branch of the artery.

Branches of the nerve.

Section II.

THE BUTTOCK, OR THE GLUTEAL REGION.

Position. — During the dissection of the back of the thigh the body is placed with the face down; and the pelvis is to be raised by blocks until the lower limbs hang almost vertically over the end of the dissecting table.

Position of the body.

Directions. — Now the body is turned, the student can better recognise the points of bone that mark, posteriorly, the limit between the thigh and the abdomen (p. 654.). Both this Section and the following one are to be gone

Directions.

through in the time appointed for the body to lie in its present position.

Take up the skin.

Dissection.—The integument is to be raised from the buttock by means of the following incisions:—One is to be made along the iliac crest of the hip bone and to be continued in the middle line of the sacrum to the tip of the coccyx; another is to be begun where the first terminates, and is to be carried outwards and downwards on the thigh till it is about six inches below the great trochanter. The flap of skin thus marked out above and below is to be thrown down.

Cutaneous nerves from above, where found.

Several of the cutaneous nerves of this region will be found in the fat, or beneath it, along the line of the iliac crest. Beginning in front, the student will meet first with branches of the external cutaneous rather below the crest. Crossing the crest, near its front, is an offset of the last dorsal nerve, and, farther back, another from the ilio-hypogastric nerve; whilst in a line with the outer border of the erector spinæ are two or three branches of the lumbar nerves. By the side of the sacrum and coccyx are two or three offsets of the sacral nerves.

Other nerves of small sciatic.

The remaining cutaneous nerves are derived from the small sciatic, and must be sought, beneath the fat, along the line of the lower incision, where they come from underneath the gluteus maximus; some turn upwards over that muscle, and others are directed down to the thigh.

Sources of the cutaneous nerves.

Cutaneous Nerves.—The nerves distributed in the integument of the buttock are small but numerous, and are derived from the spinal nerves (posterior primary branches), from the branches of the lumbar and sacral plexuses, and from the last dorsal nerve.

From lumbar

Branches from the lumbar and sacral nerves.—The offsets from the posterior primary branches of the *lumbar nerves* are two or three in number, and cross the crest of the hip bone at the place of attachment of the erector spinæ: they ramify in the integument covering the gluteus muscle, and some branches may be traced nearly to the trochanter major. The *branches* of the *sacral nerves* perforate the gluteus maximus near its origin, and are then directed outwards for a short distance in the integument over it. These offsets are usually three in number; the largest is opposite the lower end of the sacrum, another is near the iliac crest, and the other by the side of the coccyx.

and sacral nerves.

From lumbar plexus, through ilio-hypogastric, and external cutaneous.

Nerves from the lumbar plexus. — Parts of two nerves from the lumbar plexus, viz. ilio-hypogastric and external cutaneous, are spent in the integument of this region. The *iliac branch* of the ilio-hypogastric nerve crosses the iliac crest in front of the branches from the lumbar nerves, and extends only a short distance below the crest: this branch is very variable in size, or it may be wanting. *Offsets* of the *external cutaneous* nerve of the thigh bend backwards to the integument above the great trochanter, and cross the divisions of the branch of the last dorsal nerve.

From sacral plexus, through small sciatic.

Nerves from the sacral plexus. — Only one nerve of this plexus, the small sciatic, sends superficial branches to the buttock. Its cutaneous offsets appear along the lower border of the gluteus maximus; two or three ascend round the edge of the muscle, and are lost in the integument over the lower part; the remaining branches descend to the thigh, and will be afterwards noticed on it.

From last dorsal nerve.

The *last dorsal nerve* supplies the buttock by means of its lateral cutaneous branch (p. 468.). This offset perforates the muscles of the abdomen, and crosses the anterior part of the iliac crest to be distributed over the fore part of the gluteal region, as low as the great trochanter.

Clean gluteus maximus.

Dissection. — In the dissection of this region, the thin and unimportant deep fascia may be disregarded, in order that the great gluteal muscle which is the most difficult in the body to make clean, may be well displayed. Supposing the student desirous to lay bare the muscle at once, let him turn aside the cutaneous nerves, and draw away and rotate inwards the limb, to make tense the muscular fibres. Having cut through the fat and fascia down to the muscle, let him carry the scalpel along one bundle of fibres at a time in the direction of a line from the sacrum to the femur, until all the coarse fasciculi are cleaned. If it is the right limb, the dissection may be begun at the upper border; but if the left, at the lower margin of the muscle.

Mode of proceeding.

Fascia of the buttock is thin and unimportant.

The *fascia of the buttock* is a prolongation of that enveloping the thigh, and is fixed to the crest of the hip bone, and to the sacrum and coccyx. It is much thicker in front of than on the gluteus maximus, and gives attachment anteriorly to the gluteus medius which it covers. At the edge of the gluteus maximus the fascia is slit to incase it.

Gluteus maximus.

The GLUTEUS MAXIMUS is the most superficial muscle of the buttock, and reaches from the pelvis to the upper part of the femur. Its origin from the pelvis is partly osseous and

Origin above from pelvis; partly aponeurotic: — thus it is attached superiorly to the innominate bone, viz. to the posterior fourth of the iliac crest, and to a special impression on the bone below the crest; inferiorly it is connected with the back of the last piece of the sacrum, with the side of the coccyx, and with the great sacro-sciatic ligament; and between the inner and outer osseous attachments it is fixed into the aponeurosis covering the multifidus spinæ muscle. From this origin the fibres are directed outwards to their *insertion:* — the upper fibres (about two thirds) with a few of the lowest fibres end in the fascia lata of the outer part of the thigh; and the remainder are fixed into the femur in the lower part (three inches) of the line leading from the linea aspera to the great trochanter. The gluteus forms the prominence of the buttock, and resembles the deltoid muscle of the arm in situation and in the coarseness of its texture. Its cutaneous surface is covered by the common investing fasciæ of the limb, and the superficial nerves; the parts in contact with the under surface will be seen when the muscle is cut through. The upper border overlies the gluteus medius; and the lower border, which is longer and thicker than the upper, forms the fold of the nates and bounds posteriorly the perinæal space. Beneath the lower border the hamstring muscles and the sciatic vessels and nerve are placed.

inserted below into the femur.

Connections of the surfaces

and borders.

Divide the gluteus maximus. *Dissection.* — The gluteus maximus is to be cut across near the pelvis but external to the sacral nerves perforating it, and without injuring the subjacent sacro-sciatic ligament, to which the lower fibres are closely joined. The depth of the muscle will be ascertained by the fascia beneath it, and by some vessels. When this intermuscular layer is arrived at, the outer part of the gluteus is to be thrown towards its insertion, and the sciatic artery and nerves are to be detached from the under surface, though the branches that enter the muscular surface must be cut.

Clean parts beneath. The loose fat is to be taken away from the hollow between the pelvis and the trochanter, without injuring the vessels and nerves; the several muscles of this region are then to be cleaned, and the fibres of each are to be made tense, at the time of its dissection, by rotating the femur. In removing the fat from the ischial tuberosity and from the great trochanter, the bursa on each prominence of bone should be observed.

The vessels, nerves, and muscles to be made out in this region, are noticed below in the enumeration of the parts beneath the gluteus.

Lastly, the origin of the muscle is to be removed; and the sacral nerves, being dissected out of it, are to be followed to the surface of the great sacro-sciatic ligament, where they are united, and concealed by some aponeurotic fibres. Dissect out sacral nerves.

Parts beneath the gluteus. — At its origin the gluteus maximus rests on the pelvis, and conceals part of the hip bone, sacrum, and coccyx; above, the muscle covers also the ischial tuberosity, the origin of the hamstring muscles, and the great sacro-sciatic ligament. At its insertion it covers the upper end of the femur with the great trochanter, and the origin of the vastus externus. Between the muscle and each prominence of bone (tuberosity and trochanter) is a large, loose synovial membrane; and between it and the vastus externus is another synovial sac. Parts covered by gluteus at its origin and insertion,

In the hollow between the pelvis and the femur the muscle conceals, from above downwards, the undermentioned parts: — First is a portion of the gluteus medius; and below it is the pyriformis, with the superficial branch of the gluteal artery between them. Coming from beneath the pyriformis are the sciatic vessels, and the sciatic nerves (large and small), which descend to the back of the thigh between the great trochanter and the ischial tuberosity; with these are the pudic vessels and nerve, and the nerve to the obturator internus muscle, which are directed inwards through the small sacro-sciatic notch. Still lower down is the tendon of the obturator internus muscle, with a fleshy fasciculus (gemellus) above and below it. Next follow the thin quadratus femoris muscle, and the upper part of the adductor magnus; at the upper border of the quadratus is the tendon of the obturator externus, and at the lower border, between it and the adductor, is one of the terminal branches of the internal circumflex artery. and by the intervening part of the muscle.

Sacral nerves. — The external branches of the posterior divisions of the first three sacral nerves, after passing outwards beneath the multifidus spinæ (p. 427.), are joined by loops on the surface of the great sacro-sciatic ligament. Two or three cutaneous offsets are derived from this inter- The external branches of sacral nerves are united beneath gluteus.

communication, and pierce the fibres of the gluteus maximus to be distributed on the surface (p. 693.).

Gluteus medius

The GLUTEUS MEDIUS is triangular in form, with its base at the innominate bone, and its apex at the femur. It

arises from hip bone,

arises from the outer surface of the hip bone, between the crest and the superior curved line, except where the gluteus maximus is attached behind; and from the strong fascia covering its anterior part. The fibres of origin converge to

and inserted into trochanter.

a tendon which is *inserted* into an impression across the outer surface of the great trochanter, extending from the tip behind to the root in front. The superficial surface is con-

Connections.

cealed in part by the gluteus maximus; and the deep is in contact with the gluteus minimus, and the gluteal vessels and nerve. The anterior border lies over the gluteus minimus, and the posterior is contiguous to the pyriformis, only the gluteal artery intervening. A small bursa is between the tendon of insertion and the trochanter.

Detach gluteus medius to see gluteal vessels

Dissection.—When the gluteus medius is detached from the pelvis, and partly separated from the gluteus minimus beneath, the gluteal vessels and nerve will come into view. The two chief branches of the artery and nerve,—one being near the iliac crest, and the other lower down,—are to be traced through the fleshy fibres as the reflection of the gluteus

and nerve.

is proceeded with; and the lower part of the nerve is to be followed on at the same time to the tensor vaginæ femoris muscle. A branch of the artery to the gluteus maximus has necessarily been cut in removing that muscle.

Gluteal artery is

The *gluteal artery* is the largest branch of the internal iliac (p. 608.), and issues from the pelvis above the pyriformis muscle. On the dorsum of the hip bone it ends in

divided into two:

offsets that supply the gluteal muscles and the bone, and anastomose with the other branches in this situation. Its named branches are superficial and deep:—

superficial and

a. The *superficial* branch sends inwards a few twigs over the sacrum, and ends in the gluteus maximus, which it penetrates on the under surface.

deep branch:

b. The *deep branch* is the continuation of the artery, and lies between the two smaller gluteal muscles: it subdivides into two pieces. One (superior) courses along the origin of the gluteus

this has an upper

minimus, with a branch of the nerve, to the front of the iliac crest, where it anastomoses with the ascending branches of the

and a

external circumflex artery. The other division (inferior) is

directed forwards over the middle of the smallest gluteal muscle, towards the anterior lower iliac spine and the great trochanter, and communicates also with the external circumflex branches; some offsets from it pierce the muscle to supply the hip-joint. lower piece.

Vein. — The companion vein of this artery enters the pelvis, and ends in the internal iliac vein. Gluteal vein.

The *superior gluteal nerve* is a branch of the lumbo-sacral cord (p. 583.). It accompanies the gluteal artery, and divides, like it, into two branches for the supply of the two smallest gluteal muscles; the lower branch may be traced forwards into the tensor vaginæ femoris. Superior gluteal nerve is muscular.

The GLUTEUS MINIMUS is likewise conical in shape, and *arises* from the dorsum of the hip bone between the superior and inferior curved lines on the bone.* The fibres are collected on a tendon, which is *inserted* into an oblique impression along the fore part of the great trochanter, and is united inferiorly with the gluteus medius. One surface is in contact with the gluteus medius, and the gluteal vessels and nerve; the other with the hip joint and the bone, and the outer head of the rectus femoris muscle. The anterior border lies by the side of the other gluteus; and the posterior touches the pyriformis muscle. A bursa is between the tendon and the bone. Gluteus minimus. Attachments. Is next the bone, and is joined with preceding.

Dissection. — The smallest gluteal muscle should be cut through near the innominate bone, and the tendinous part of the rectus femoris defined close above the hip joint. Whilst detaching the gluteus from the parts beneath, the student cannot fail to notice the connection between its tendon and the capsule of the joint. The deep vessels to the articulation may be observed and followed after the muscle is removed. Divide smallest gluteus.

The *outer head* of the *rectus femoris* is a slip of tendon about two inches long, which reaches outwards, almost horizontally, above the margin of the acetabulum. In front it joins the other tendinous piece of the rectus, which is attached to the anterior inferior iliac spine; and below it is connected by fibres with the capsule of the hip joint. Outer head of the rectus; where attached.

The PYRIFORMIS *arises* in the pelvis from the front of the sacrum (p. 643.), and comes from that cavity through the Origin of pyriformis in the pelvis.

* Its extent is larger than that given usually to the muscle. For the limit of the lower line see Quain's Anatomy, vol. i. p. 138.

great sacro-sciatic notch. Outside the pelvis it ends in a tendon, and is *inserted* into the upper border of the great trochanter, in front of the gluteus medius, where it is commonly united with the tendon of the obturator internus. As the muscle passes through the sacro-sciatic notch it divides that space into two parts: the upper of these gives passage to the gluteal vessels and nerve, and the lower to the sciatic and pudic vessels and nerves. Its upper border is contiguous to the gluteus medius, and its lower edge to the gemellus superior. Like the other rotator muscles in this situation, it is covered by the gluteus maximus, and rests on the hip joint.

Insertion into the femur; lies in sacro-sciatic notch; Position to other parts.

Dissection. — The pyriformis may be cut across, and raised towards the sacrum, to allow the dissector to trace upwards the sciatic and pudic vessels, and the corresponding nerves to the lower part of the sacral plexus. Some small offsets to the gemellus superior and the hip joint are to be sought at the lower part of the plexus. A branch to the inferior gemellus and the quadratus will be found by raising the trunk of the great sciatic nerve; but it will be followed to its termination afterwards, since it passes beneath those muscles.

Dissect out the vessels and the nerves.

Sciatic and Pudic Vessels. — The vessels on the back of the pelvis, below the pyriformis muscle, are branches of the internal iliac, like the gluteal artery (p. 610.).

The vessels come from the iliac.

The *sciatic artery* supplies the buttock. After escaping from the pelvis below the pyriformis, it descends over the gemelli and obturator muscles, in the interval between the tuber ischii and the trochanter, as far as the quadratus femoris; here the artery ends in branches for the supply of the surrounding parts, and anastomoses with the internal circumflex branch of the profunda artery. In this course it furnishes *muscular* offsets to the great gluteus and the rotator muscles, and some *articular* branches to the hip joint; some cutaneous offsets bend round the margin of the gluteus (p. 448.). It supplies also the following named branches: —

Sciatic artery; course and ending. Branches to joint and muscles.

a. The *coccygeal branch*, arising close to the pelvis, perforates the great sacro-sciatic ligament and the gluteus maximus, and ramifies in this muscle, and on the back of the sacrum.

Coccygeal branch.

b. The *branch* to the great *sciatic nerve* (comes nervi ischiadici)

Branch to the

is very slender, and enters the substance of the nerve near the pelvis; it extends in the nerve along the thigh, supplying offsets to it. sciatic nerve.

c. The *branch to the quadratus* passes with the nerve of the same name beneath the gemelli and obturator internus, and gives branches to the hip joint and the inferior gemellus before it terminates in its muscle. Branch to the quadratus.

The *pudic artery* belongs to the perinæum and the genital organs: it is less than the sciatic, and internal to it. Only a small part of the vessel is seen on the back of the pelvis, for, after winding over the ischial spine, it enters the perinæal space through the small sacro-sciatic notch, and is there distributed (p. 458.). It supplies a small branch over the back of the sacrum, which anastomoses with the gluteal and sciatic vessels; and a twig from it accompanies the nerve to the obturator internus muscle. Pudic artery crosses the ischial spine.

The *veins* with the sciatic and pudic arteries receive contributing twigs corresponding with the branches of those arteries, and open into the internal iliac vein. Veins.

SCIATIC AND PUDIC NERVES.—The nerves appearing at the back of the pelvis, below the pyriformis, are branches of the sacral plexus to the lower limb, and mostly to parts beyond the gluteal region (p. 614.). Some small muscular branches are present at the same spot. Nerves come from sacral plexus.

The *small sciatic* may be considered a cutaneous nerve of the back of the thigh, for it supplies only one muscle — the gluteus maximus: it springs from the lower part of the sacral plexus, generally by two parts that remain separate. The nerve takes the course of the sciatic artery as far as the lower border of the great gluteus, where it gives many cutaneous branches upwards and downwards: much diminished in size at that spot, the nerve is continued along the back of the thigh, beneath the fascia, and ends in the integument of the posterior part of the leg. The branches which are distributed on or near the buttock are muscular and cutaneous. Small sciatic nerve is chiefly a cutaneous nerve; ends in the leg;

a. The *muscular branches* (inferior gluteal) enter the under surface of the gluteus maximus near the lower border. A separate offset of the sacral plexus is usually furnished to the upper part of the muscle. gives branches to gluteus maximus.

b. The *cutaneous branches* are directed either upwards or downwards at the border of the gluteus. The *upper* set are distributed Cutaneous nerves

over the buttock and to the thigh; one of the last set named pudendal.

in the superficial fascia over the lower part of the muscle. The *lower* set supply the integument of the inner side of the thigh at the posterior aspect. One of these branches, which is larger than the others, is distributed to the genital organs, and is named *inferior pudendal* (p. 452.); as it courses to the perinæum, it turns below the ischial tuberosity, and perforates the fascia lata only when it has nearly reached the perinæal space. Sometimes the inferior pudendal is a distinct branch of the plexus.

Great sciatic nerve; outline of, and ending; course in the buttock.

The *great sciatic* is the largest nerve in the body, and is the source of all the muscular, and most of the cutaneous branches beyond the knee, as well as of the muscular branches at the back of the thigh. At its origin it appears to be a prolongation of the interlacement of the nerves of the sacral plexus. After leaving the pelvis, it is directed through the region of the buttock to the posterior part of the thigh, where it divides into branches for the leg. In the part of its course now dissected, viz., to the lower border of the gluteus maximus, it lies in the hollow between the tuber ischii and the great trochanter, and rests on the external rotator muscles below the pyriformis. Oftentimes the nerve is divided into two large trunks at its origin, and one of them pierces the fibres of the pyriformis muscle. Commonly it does not supply any branch to the buttock, but it may give origin to one or two filaments to the hip joint.

No branch in this part.

Pudic nerve.

The *pudic nerve* winds over the ischial spine of the hip bone with its companion artery and the nerve to the obturator internus muscle, and is distributed with the vessel to the perinæum and the genital organs (p. 459.). No branch is supplied by it to the buttock.

Other branches of the plexus.

The remaining muscular and articular branches are derived from the lower part of the sacral plexus.

Nerves to the hip;

Some *nerves* to the *hip joint* perforate the back of the capsular ligament, and supply the articulation.

to superior gemellus.

A *nerve* to the *superior gemellus* is a very small twig, and arises separately from the lower part of the plexus.

Nerve to gemellus and quadratus.

A *nerve* to the *inferior gemellus* and the *quadratus* is a slender branch; it passes with a companion artery beneath the gemelli and the obturator internus, and ends in the two muscles from which it receives its designation. This nerve will be more fully seen in a subsequent dissection, when *articular* filaments from it to the hip joint may be recognised.

Dissection.—To see the remaining small rotator muscles, hook aside the great sciatic nerve, and take away the branches of the sciatic artery if it is necessary. In cleaning these muscles the limb should be kept rotated inwards. The gemelli are to be turned aside from the tendon of the obturator internus.

Clean rotator muscles.

The SUPERIOR GEMELLUS is the highest of the two muscular slips along the sides of the tendon of the obturator muscle. Internally it is attached to the ischial spine, and externally it is inserted with the obturator into the great trochanter. Oftentimes this muscle is absent.

Superior gemellus is often absent.

The INFERIOR GEMELLUS is larger and more constant than its fellow. Its *origin* is connected with the upper and hinder part of the ischial tuberosity, and its *insertion* is the same as that of the obturator tendon. This muscle is placed between the obturator internus and quadratus muscles, but near the femur the tendon of the obturator externus comes into contact with its lower border.

Inferior gemellus inserted with obturator.

The OBTURATOR INTERNUS arises inside the pelvis, and passes to the exterior through the small sacro-sciatic notch (p. 644.). Escaped from the pelvis, the muscle is directed outwards over the articulation of the hip, and is *inserted* by a tendon with the gemelli into the upper part of the great trochanter, in front of the pyriformis, as well as into the contiguous portion of the neck of the femur. Outside the pelvis the obturator is mostly tendinous, and is embraced by the gemelli muscles; beneath it is a synovial sac. Crossing the muscle are the large and small sciatic nerves, and the sciatic vessels; and covering the whole is the gluteus maximus. On cutting through the tendon, and raising the inner end, it will be found divided into four or five pieces as it turns over the margin of the pelvis; at this spot the pelvis is marked by ridges of fibro-cartilage, that correspond with the intervals between the tendons, and the whole is lubricated by another synovial membrane.

Obturator internus has part inside and part outside pelvis; latter part lies over hip joint; its tendon is divided on the edge of the pelvis.

The QUADRATUS FEMORIS has the form expressed by its name, and is situate between the inferior gemellus and the adductor magnus. Internally it *arises* from the outer border of the tuber ischii, along the side of the origin of the semimembranosus and part of the adductor magnus; externally it is *inserted* into the linea quadrati of the upper end of the

Quadratus femoris; origin; insertion;

femur, above the attachment of the great adductor to the same line. By one surface it is in contact with the sciatic vessels and nerves and the gluteus; and by the other surface it rests on the obturator externus, the internal circumflex artery, and the small branches of both the nerve and artery that supply it. Between its lower border and the adductor magnus one of the terminal branches of the internal circumflex artery issues. Between it and the small trochanter is a bursa, which is common also to the upper part of the adductor magnus.

parts above and beneath it, and at lower border.

Dissection.—The quadratus and the gemelli muscles may now be cut across, so that the obturator externus, the ending of the internal circumflex artery, and the small nerve and artery to the same muscles, may be dissected out.

Dissect circumflex artery.

The *internal circumflex* branch of the profunda artery (p. 687.) divides finally into two parts. One ascends beneath the quadratus, in this position of the body, to the pit of the trochanter, where it anastomoses with the gluteal artery, and supplies the bone. The other passes between the quadratus and adductor magnus to the hamstring muscles, and communicates likewise with the sciatic artery.

Internal circumflex artery ends in two branches.

The OBTURATOR EXTERNUS has been dissected at its origin in the front of the thigh (p. 690.). In the part of its course now laid bare, the muscle winds backwards below the hip joint, and ascends from that position to be *inserted* into the pit at the root of the great trochanter. On the back of the pelvis the obturator externus is covered by the quadratus, except near the femur, where the upper border is in contact with the inferior gemellus.

Obturator externus is inserted into the trochanter. Connections.

The SACRO-SCIATIC LIGAMENTS pass from the innominate bone to the sacrum and the coccyx; they are two in number, and are named large and small.

Sacro-sciatic ligaments.

The *large* or *posterior* ligament is attached internally to the posterior lower iliac spine, and to the side of the sacrum and coccyx; and externally it is inserted into an impression on the inner and anterior part of the ischial tuberosity. It is wide next the sacrum, but is contracted towards the middle, and is expanded again at the tuberosity; from its outer attachment it sends upwards a prolongation along the pubic arch. On the cutaneous surface are the branches of

Attachments of the large one. Form; gives a prolongation.

the sacral nerves; and the gluteus maximus conceals and takes origin from it.

The *small ligament* will be seen on dividing the other near the hip bone. At the sacrum and coccyx it is united with the large ligamentous band, but at the opposite end it is inserted into the ischial spine. It is less strong than the superficial ligament, by which it is concealed, and rests on the coccygeus muscle. Small ligament attachments;

These ligaments convert the large sacro-sciatic notch of the dried pelvis into two apertures or foramina by their attachments to the bones. Between the insertion of both into the innominate bone (the spine and tuberosity) is the small sacro-sciatic foramen, which contains the internal obturator muscle with its nerve, and the pudic vessels and nerve. Whilst above the smaller ligament is the large sacro-sciatic foramen, which gives passage to the pyriformis muscle, and several vessels and nerves, viz. the gluteal vessels, and the superior gluteal nerve above, and the sciatic and pudic vessels and nerves, with some muscular branches of the sacral plexus below the muscle. they give rise to two notches: small, with contents; large, and parts passing through it.

Section III.

THE BACK OF THE THIGH.

Directions.—The ham or the popliteal space may be dissected after the buttock, in order that it may be seen with its size and boundaries less disturbed than they would be if it was dissected subsequently to the examination of the muscles at the back of the thigh. When this space has been learnt the student will return to the dissection of the thigh. Directions.

Position.—The limb is to remain in the same position as in the dissection of the buttock. Position.

Dissection.—To remove the skin from the popliteal region, let an incision be made behind the knee joint, beginning it about six inches above the knee, and ending it four inches below the joint. At each extremity of this longitudinal cut, let a transverse incision be made, so as to allow the skin to be raised in two flaps, the one being turned outwards, and the other inwards. Take the skin from over the ham.

Seek the cutaneous nerves.

In the superficial fascia some small cutaneous nerves may be found, viz. one or two twigs in the middle line of the limb from the small sciatic nerve beneath the fascia; and some offsets of the internal cutaneous towards the inner part.

Fascia of the limb over the ham.

Fascia lata.—After the fat is removed, the special fascia of the limb will be brought into view. Where it covers the popliteal space it is strengthened by transverse fibres, particularly on the outer side; and at each side it is connected with the tendons bounding that interval. The short saphenous vein perforates it sometimes opposite the knee, but usually at a spot lower down.

Remove fascia,

Dissection.—The fascia over the ham is now to be removed without injuring the small sciatic nerve and the short

and take the fat from the ham.

saphenous vein, which are beneath it. A large quantity of fat may be next taken out of the space, and the several vessels and nerves looked for. After the ham has been cleaned, the sartorius and the gracilis are to be replaced on the inner side.

Seek the nerves in the space,

In the middle line the student will first come upon the large internal popliteal nerve, and nearer the outer side, on the external popliteal; both give branches, and their offsets will be recognised more certainly by tracing them from above down along the trunk of the nerve, than by proceeding in the opposite direction. In fat bodies the small nerves to the knee joint are difficult to find. Under cover of the outer boundary, and deep in the space, is an articular nerve (external), which sometimes arises from the great sciatic.

and clean the vessels,

In the bottom of the space are the popliteal vessels, and the vein is more superficial than the artery. The student is to seek an articular branch (superior), on each side, close above the condyle of the femur. Numerous other branches of the vessels to the muscles around, especially below, are to

with obturator nerve.

be cleaned. On the upper part of the artery, the branch of nerve from the obturator to the knee joint may be found.

The ham;

The POPLITEAL SPACE, or the ham, is the hollow behind the knee which allows of the free flexion of the joint. In it

situation and extent.

the large vessels of the limb are contained. When dissected, this interval has the form of a lozenge, and extends upwards along one third of the femur, and downwards along one sixth of the tibia; but in the natural condition of the parts the

sides are approximated by the fascia of the limb, and the space is limited almost to the region of the joint.

This hollow is situate between the attachments of the muscles on the back of the limb to the femur, and the lateral boundaries are therefore formed in part by the muscles of the thigh (hamstrings), and in part by those of the leg. Thus, on the outer side, is the biceps muscle as far as the joint, and the plantaris and the external head of the gastrocnemius beyond that spot. On the inner side, as low as the articulation, are the semimembranosus and semitendinosus muscles, with the gracilis and sartorius between them and the femur; and beyond the joint is the inner head of the gastrocnemius. The upper point of the ham is limited by the apposition of the inner and outer hamstring muscles, in the middle line of the thigh; and the lower point, by the union of the heads of the gastrocnemius. Stretched across this cavity is the fascia lata; and, forming the deep boundary, or the floor, are the following parts,— the lower end of the posterior surface of the femur included between the lines to the condyles, as well as the posterior ligament of the knee joint, and the popliteus muscle with the upper end of the tibia.

Boundaries; outer and inner. Limit above and below. Deep boundary.

The popliteal space is widest opposite the knee joint, where the muscles are most drawn to the sides, and is deepest above the articular end of the femur. In it are contained the popliteal vessels and their branches, and the ending of the external saphenous vein; the popliteal divisions of the great sciatic nerve, and some of their branches; with some lymphatic glands, and a large quantity of fat. The small sciatic nerve lies over the space; and a branch of the obturator is on the artery in the bottom of the hollow.

Greatest width and depth; contents.

The POPLITEAL ARTERY is the continuation of the femoral trunk, and reaches from the opening in the adductor magnus to the lower border of the popliteus muscle; at this spot it terminates by bifurcating into the anterior and posterior tibial vessels. In a part of its extent it lies in the ham, and is uncovered by muscle; but, inferiorly, it is beneath the gastrocnemius, and beyond the limits of the popliteal space as above defined: the description of the artery may therefore be divided into two parts, corresponding with the difference in the connections.

Popliteal artery; extent; part is in the ham, and part beyond.

The part in the space; course and connections. In the ham the vessel is inclined obliquely from the inner side of the limb to the interval between the condyles of the femur, and is then directed along the middle of the space over the knee joint. In this course it is overlaid at first by the belly of the semimembranosus muscle, but thence onwards to the gastrocnemius it is covered only by the fat, the fascia lata, and the integuments. Beneath it is the lower part of the posterior surface of the femur, together with the posterior ligament of the knee joint. Position of vein In contact with the vessel, and somewhat on its outer side, lies the popliteal vein, so that, on looking into the space, the arterial trunk is almost covered by it; but, lower down, in the interval between the heads of the gastrocnemius, the vein and its branches altogether conceal the artery. More superficial than the large vessels, and slightly external to them in position, and of the nerve. is placed the internal popliteal nerve, which however, like the vein, lies over the artery between the heads of the gastrocnemius.

Cut the head of the gastrocnemius. *Dissection.*—To see the artery beneath the gastrocnemius the inner head of this muscle should be cut through, and raised from the subjacent parts. On removing the areolar tissue the vessels and nerves will appear. The lower articular branches of the vessels and nerves are now brought into view;—the inner artery is below the head of the tibia, and the outer higher up between the tibia and fibula, each with a vein and a nerve.

Connections of the artery farther on. Whilst the *artery* is beneath the gastrocnemius it sinks deeply into the limb, and is crossed by a small muscle, the plantaris. It is placed on the popliteus muscle. Position of vein and nerve. Both the vein and the nerve (internal popliteal) change their position to the artery, and gradually cross over it, so as to lie on its inner side at the lower border of the popliteus.

Branches. *Branches* are furnished by the artery to the surrounding muscles, and to the articulation; those that enter the joint are five in number, and are called articular, viz. two superior, inner and outer; two inferior, also inner and outer; and a central or azygos branch.

Muscular branches and cutaneous. The *muscular branches* have not received separate names, with the exception of those to the gastrocnemius and soleus, which are called *sural* arteries. One superficial or cutaneous

branch accompanies the short saphenous nerve above the muscles of the leg.

The *superior articular* arteries arise from the popliteal trunk, one from the inner and one from the outer side, above the condyles of the femur; they are directed almost transversely beneath the hamstring muscles, and turn round the bone to the front of the joint. Branches to the joint are five; two superior,

The *external* one perforates the intermuscular septum, and divides in the substance of the vastus externus: some of the branches end in that muscle, and anastomose with the external circumflex (of the profunda); others descend to the joint; and one offset forms an arch across the bone with the anastomotic artery. external

The *internal* artery, oftentimes very small, winds beneath the tendon of the adductor magnus, and terminates in branches in the vastus internus, which supply it and the knee joint, and communicate with the anastomotic artery. and internal.

The *inferior articular* branches lie beneath the gastrocnemius, but are not on the same level on the two sides of the limb, for the inner one descends below the head of the tibia, whilst the outer one is placed above the fibula. Each lies beneath the lateral ligament of its own side. Two inferior;

The *external* branch supplies the outer side of the knee joint, and anastomoses with the other vessels on the articulation, and with the recurrent branch of the anterior tibial artery: it sends an offset beneath the ligament of the patella to join a twig from the lower internal branch. also external

The *internal* artery turns upwards to the joint at the anterior border of the internal lateral ligament, and after taking its share in the free anastomoses over the joint, ends in offsets for the articulation and the head of the tibia. and internal;

The *azygos* branch enters the back of the joint through the posterior ligament, and is distributed to the ligamentous structures and the synovial membrane of the interior. and one central artery.

The POPLITEAL VEIN originates in the union of the venæ comites of the anterior and posterior tibial vessels, and has the same extent and connections as the artery it accompanies. At the lower border of the popliteus muscle the vein is internal to the arterial trunk; between the heads of the gastrocnemius it is superficial to that vessel; and thence to the opening in the adductor magnus it is to the outer side, and close to the artery. It is joined by branches corresponding with those of the artery, as well as by the short saphenous vein. Popliteal vein. Position to the artery. Branches.

Popliteal artery may divide soon.

Peculiarities in the division of the artery.—The chief peculiarity of the popliteal artery consists in its early division into terminal branches. In some bodies the artery will be found divided as high as the back of the knee joint, and in such instances the anterior tibial artery may lie beneath the popliteus muscle.

Vein may leave the artery

Course and position of the vein.— Occasionally the vein will be placed on the inner instead of the outer side of the artery. The popliteal vein may pass through the adductor magnus at a spot higher than the common opening, and enter the profunda vein.

or be split.

Double vein.— Or there may be a venous trunk on each side of the artery for a certain distance, in consequence of the venæ comites of the tibial arteries not being blended together as soon as is usually the case.

Popliteal nerves are two, inner and outer.

The POPLITEAL NERVES are two large trunks that are derived from the division of the great sciatic in the thigh; they are named internal and external from their relative position. In the popliteal space each furnishes cutaneous and articular offsets, but only the inner one supplies branches to muscles.

The internal nerve in the space.

The *internal popliteal* nerve is larger than the external, and occupies the middle of the ham. Its connections are the same as those of the artery, that is to say, it is partly superficial and partly covered by the gastrocnemius: like the vessel it extends through the back of the leg, and retains the name popliteal only to the lower border of the popliteus muscle. Its position with reference to the vessels has been already noticed. The branches that arise from it here are the following:—

Branches are

two or three articular;

Two or three small *articular* twigs are furnished to the knee joint with the vessels. One is with the lower internal articular artery, and is of considerable size; and another takes the same course as the azygos artery. Occasionally a third may be found with the upper internal articular artery.

to the superficial muscles of the leg, and popliteus;

Muscular branches arise from the nerve between the heads of the gastrocnemius. One supplies both heads of the gastrocnemius and the plantaris; another descends beneath the gastrocnemius and enters the cutaneous surface of the soleus; and a third penetrates the popliteus at the under aspect, after turning round the lower border.

external saphenous nerve.

The *external saphenous* nerve (ram. communicans tibialis) is the largest branch, and is a cutaneous offset to the leg and foot. It lies on the surface of the gastrocnemius, but beneath the fascia, as far as the middle of the leg, where it becomes cutaneous, and will be afterwards seen (p. 716.).

The *external popliteal nerve* (peroneal) lies along the outer boundary of the ham, and follows the biceps muscle to the head of the fibula. Below the head of that bone the nerve enters the fibres of the peroneus longus muscle, and divides beneath it into two,—musculo-cutaneous and anterior tibial. Its branches whilst in the popliteal space are cutaneous and articular. External popliteal nerve. Branches;

The *articular* nerve runs with the upper external artery to the outer side of the knee, where it sends a twig along the lower articular artery; both enter the joint. one articular;

The *peroneal communicating* branch (ram. communicans fibularis) is a cutaneous nerve, and joins the external saphenous branch of the internal popliteal about the middle of the leg. It arises near the head of the fibula, and soon pierces the deep fascia; cutaneous offsets are given by it to the back of the leg. a communicating branch;

One or two other *cutaneous* offsets are furnished by the external popliteal to the integument on the outer part of the leg in the upper half. cutaneous offsets.

The *articular branch* of the *obturator nerve* perforates the adductor magnus, and is conducted by the popliteal artery to the back of the knee joint. After supplying filaments to the vessel, the nerve enters the articulation through the posterior ligament. Articular nerve of the obturator.

The *lymphatic glands* of the popliteal space are situate around the large arterial trunk; two or three are ranged on the sides, whilst one is superficial to, and another beneath the vessel: they are joined by the deep lymphatic vessels of the lower limb, as well as by the superficial set accompanying the saphenous vein. Lymphatic glands around the artery.

Dissection. — Now the anatomy of the popliteal space has been learnt, the student may proceed with the dissection of the back of the thigh. The piece of skin therefore that remains between the buttock and the popliteal space, should be divided and reflected to the sides. Dissect the back of the thigh.

In the fat on the sides of the limb offsets of the internal and external cutaneous nerves of the front of the thigh may be found, and along the middle line, some filaments from the small sciatic nerve. Seek out cutaneous nerves.

Lastly, remove the deep fascia of the limb, taking care of the small sciatic nerve; and then clean the hamstring muscles, and trace into them branches of the great sciatic nerve. Clean muscles and nerves.

The MUSCLES ON THE BACK OF THE THIGH act as flexors of Three muscles

on back of thigh. the knee. They extend from the pelvis to the bones of the leg, and are named hamstrings from their cord-like appearance on the sides of the ham: they are three in number, Situation. viz. biceps, semitendinosus, and semimembranosus; the first of these lies on the outer, and the others on the inner side of the popliteal space.

Biceps arises by a long The BICEPS has two heads of *origin*, long and short, which are attached to the pelvis and the femur. The long head arises from an impression on the back of the ischial tuberosity, in common with the semitendinosus muscle; the and a short head; short head is fixed to the femur below the gluteus maximus, viz. to the linea aspera, to nearly the whole of the line leading inferiorly to the outer condyle, and to the external intermuscular septum. The fibres from these sources are collected together to form the belly of the muscle, and end is inserted into the fibula and tibia. inferiorly in a tendon, which is *inserted* into the head of the fibula by two processes that embrace the external lateral ligament, and slightly into the head of the tibia. The muscle is superficial, except at the origin, where it is covered by Connections of the muscle. the gluteus; and it rests on the upper part of the semimembranosus, on the great sciatic nerve, and on the adductor magnus muscle. On the inner side is the semitendinosus muscle as far as the ham. Its tendon gives offsets to the deep fascia of the limb.

Semitendinosus is attached to pelvis and tibia. The SEMITENDINOSUS is a slender muscle, and receives its name from its appearance. It *arises* from the tuberosity of the hip bone with the long head of the biceps, and by fleshy fibres from the tendon of that muscle; and inferiorly it is *inserted* into the inner surface of the tibia, close below the gracilis, and for about the same distance. This muscle, like the biceps, is partly covered by the gluteus maximus; it rests on the semimembranosus, and on the internal lateral ligament of the knee joint. A tendinous intersection is to Surrounding parts in contact with it. be observed about its middle. The outer border is in contact with the biceps as far as the popliteal space. As the tendon turns forwards to its insertion, an expansion is continued from it to the fascia of the leg. The tendon and that of the gracilis are attached below the level of the tubercle of the tibia, and are separated from the tendon of the sartorius by the bursa before referred to (p. 674.).

Semi- The SEMIMEMBRANOSUS muscle is tendinous at both ends

and its name is taken from the membraniform appearance of the upper tendon. The muscle is attached above to the highest impression on the back of the tuber ischii, above and external to the semitendinosus and biceps; and it is *inserted* below into the hinder and inner part of the head of the tibia. The muscle presents a thick fleshy belly inferiorly, where it bounds the popliteal space. On it is the semitendinosus, which is lodged in a hollow in the upper tendon; and beneath it is the adductor magnus. Along the outer border is the great sciatic nerve, and below the place of division of that nerve, is the internal popliteal trunk. Between its tendon and the inner head of the gastrocnemius is a large bursa. The insertion of the muscle will be dissected with the tendons in connection with the knee joint.

membranosus reaches from pelvis to tibia.

Parts around it.

The *great sciatic nerve* lies on the adductor magnus between the buttock and the popliteal space, and divides into the two popliteal nerves about the middle of the thigh, though its point of bifurcation may be carried upwards as far as the pelvis. In this extent the nerve lies along the outer border of the semimembranosus, and is crossed by the long head of the biceps. At its upper part it supplies branches to the flexor muscles at the back of the thigh, and to the adductor magnus.

Great sciatic nerve in the thigh

supplies flexor and adductor muscles.

Small sciatic nerve.—Between the gluteus maximus and the ham this small nerve is close beneath the fascia, but it becomes cutaneous below the knee, and accompanies the external or posterior saphenous vein for a short distance. Small *cutaneous* filaments pierce the fascia of the thigh, and the largest of these is near the popliteal space.

Small sciatic in the thigh;

cutaneous offsets.

Dissection.—To see the posterior surface of the adductor magnus, and the branches of the perforating arteries, the hamstring muscles must be detached from the hip bone and thrown down, and the branches of arteries and nerves they receive may be cut through if it is necessary. The parts referred to are to be cleaned.

Detach the hamstrings.

Adductor magnus muscle. — At its posterior aspect the large adductor is altogether fleshy, even to the opening for the femoral artery; and the fibres from the pubic arch appear to form a part almost distinct from those connected with the tuberosity of the hip bone. In contact with this

Posterior surface of adductor magnus.

surface are the hamstring muscles and the great sciatic nerve.

Number of arteries. *Ending of the perforating arteries.* — These arteries are four in number, and the spots at which they pierce the adductor muscles have been before referred to (p. 688.).

Muscles supplied On the back of the thigh all of them supply offsets to the flexor muscles of the leg, and end in the vastus externus. The lowest three are directed outwards to the vastus close to the bone, and usually through the short head of the biceps, though the second perforating artery may run higher up than the attachment of the head of the biceps. end in vastus externus.

Hip joint, how formed; THE HIP JOINT. — This articulation is a ball and socket joint, in which the head of the femur is received into the acetabulum, or the cup-shaped cavity of the innominate bone. its ligaments. Connecting the bones are the following ligaments: — one to deepen the receiving cavity, which is named cotyloid; another between the articular surfaces of the bones, the interarticular; and a loose capsule around all.

Lay bare the capsule. *Dissection.* — The muscles are to be taken away from the back of the hip joint, and the upper and lower attachments of the capsular ligament to be defined. Afterwards the front of the joint should be dissected in the same manner, with the body turned over for a short time, if this change in the position does not interfere with the other dissections.

Capsule. The *capsular ligament* is a loose fibrous covering that is fixed by one end around the acetabulum, and by the other to the neck of the femur. Attachments above Its upper margin is attached to the circumference of the acetabular cavity at a short distance from the edge, as well as to a transverse ligamentous band over the notch at the inner side of the cavity. and below. Its lower margin is inserted in front into the anterior intertrochanteric line, and behind by a very thin attachment into the neck of the femur about a finger's breadth from the posterior intertrochanteric line and the trochanters. The capsule is thinnest below, where it is in contact with the obturator externus. On the front is a band of fibres. In front it is thickened by a band of fibres — *ilio-femoral* ligament, which crosses from the lower of the two anterior iliac spines to the trochanteric line; and at the Another outside. upper and outer part there is another strong band, which is attached externally to the top of the great trochanter in

front, and is connected with the tendon of the gluteus minimus. Posteriorly the joint is covered by the external rotator muscles, and anteriorly by the psoas and iliacus, a bursa being between them. Above is the gluteus medius, and below is the obturator externus. Muscles around.

Dissection. — The capsular ligament should be divided over the prominence of the head of the femur, and this bone disarticulated to see the cotyloid and interarticular ligaments. Cut open the capsule.

The *cotyloid ligament* is a band of fibro-cartilage, which is fixed to the margin of the acetabulum, and is prolonged across the notch on the inner side, so as to form part of the *transverse* ligament. It is thickest at its attachment to the bone, and becomes gradually thinner towards the free margin, where it is applied to the head of the femur. This ligament deepens the socket for the femur in the same manner as the glenoid ligament increases the surface for the reception of the head of the humerus. Cotyloid ligament attached around acetabulum.

The *transverse ligament* is a firm but narrow band, which reaches across the notch at the inner side of the acetabulum: it consists partly of special fibres that are attached to the margins of the notch, and partly of some from the cotyloid ligament. Beneath it is an aperture by which the vessels enter the acetabulum to nourish the fat in the bottom of that hollow. Transverse ligament, how formed, forms a hole with bone.

The *interarticular ligament* (ligam. teres) is a strong band connecting the femur with the innominate bone. One extremity is roundish, and is inserted into the pit in the head of the femur; the other is bifid, and is connected to the sides of the notch in the cotyloid cavity, the lowest lip of the notch receiving the strongest band. Round ligament is divided externally.

A *synovial membrane* lines the capsular ligament, and is continued along it to the acetabulum and the head of the femur. In the bottom of the cotyloid cavity it is reflected over the fat in that situation, and surrounds the ligamentum teres. Synovial membrane.

Dissection.—To see the surface of the acetabulum the lower limb is to be separated from the trunk by dividing the interarticular ligament, and cutting through any parts that attach it to the rest of the body. Detach the limb.

Surfaces of bone. — The articular surfaces of the bones are Articular sur-

faces of the bones. not completely covered with cartilage. In the head of the femur is a pit into which the round ligament is inserted. In the bottom of the acetabulum is a space free from cartilage, in which a reddish fatty mass is lodged: this is sometimes called the synovial gland. Beneath the transverse ligament an artery and a nerve enter the joint to supply the fat.

Synovial gland.

Section IV.

THE BACK OF THE LEG.

Examine the surface.

Directions.—Before the dissection of the leg is begun, the student should make himself acquainted, as in the thigh, with the prominences of bone and muscle on the surface, and with the markings that lead to the position of the subjacent vessels.

In the leg the tibia and fibula are superficial.

Prominences on the surface.—The bones of the leg can be traced beneath the skin from the knee to the ankle joint. On the inner side of the limb is the tibia, which is subcutaneous in all its extent, and is limited in front and behind by a sharp ridge. Above, it presents in front a prominent tubercle into which the ligament of the patella is inserted; and below, it ends on the inner side of the ankle in the internal maleolar projection. On the outer side of the leg the lower half of the fibula may be felt with ease, but the upper half with more difficulty, in consequence of the prominence of the muscles of the calf. The head of this bone may be recognised below the knee; and the lower end forms the projection (malleolus) on the outer side of the ankle joint.

Behind is calf of the leg, tendo Achillis, and tibial vessels.

On the posterior aspect of the leg is the projection of the calf: this is formed by the superficial muscles, and from it descends the firm band of the tendo Achillis, by which those muscles are connected with the heel. Between the tendon and the edge of the tibia, but nearest the former, is the superficial part of the posterior tibial artery. In front, between the tibia and fibula, are the extensor muscles of the foot and toes, amongst which the anterior tibial artery lies deeply; the position of the vessel will be indicated by a line from the centre of the ankle joint, to the inner side of the head of the fibula.

Before, anterior tibial vessels.

Ankle joint.

On the sides of the ankle joint are the prominent malleoli;

and when the joint is extended, the head of the astragalus projects below the border of the tibia.

Inner border of the foot.

At the inner border of the foot, about an inch from the internal malleolus, is the prominent scaphoid bone pointing out the spot at which an amputation (that of Chopart) is practised; whilst farther forwards, by about one inch and a half, is a slight depression that marks the articulation between the internal cuneiform bone and the metatarsal bone of the great toe. About the centre of the outer border of the foot is the eminence of the tarsal end of the fifth metatarsal bone. A line over the dorsum of the foot, from the centre of the ankle joint to the interval between the inner two toes, will be over the position of the artery of this part.

Outer border.

Dorsal artery.

Position of the part.

Position.—For the dissection of the back of the leg the limb is to be placed on its front, with the foot over the side of the dissecting-table, and the muscles of the calf are to be put on the stretch by fastening the foot.

Take away the skin.

Dissection.—For the removal of the skin, one cut may be made along the middle of the leg to the sole of the foot, where a transverse incision is to be carried over the heel. The two resulting flaps of skin may be raised; the outer one is to be detached as far as the fibula, and the other as far as the inner margin of the tibia.

Seek cutaneous nerves in the fat.

In the superficial fascia the cutaneous nerves and vessels are to be followed. On the inner side, close to the tibia, is the internal saphenous vein with the nerve of the same name, together with twigs of the internal cutaneous near the knee. In the centre is the external saphenous vein, with the small sciatic nerve above, and the external saphenous vein below the middle of the leg. On the outer side are the cutaneous offsets of the external popliteal nerve.

Superficial fascia.

The *superficial fascia* or the fatty layer of the back of the leg is least thick over the tibia. Over the line of the superficial vessels it may be separated into two layers as in the thigh.

Two superficial veins.

Superficial Veins.—Two veins appear in the dissection of the back of the leg, which are named saphenous—inner and outer.

Internal saphenous.

The *internal saphenous* vein begins in an arch on the dorsum of the foot; it ascends along the leg in front of the

inner ankle, and then behind the inner edge of the tibia, to reach the thigh, where it has been already noticed (p. 659.). In the leg the vein is joined by superficial branches, and by deep roots from the tibial veins.

External saphenous. The *external saphenous* vein begins at the outer end of the arch on the dorsum of the foot, and appears below the outer ankle. The vein then courses along the back of the leg to the ham, where it ends in the popliteal vein. It receives large branches about the heel, and others on the back of the leg.

Cutaneous nerves. CUTANEOUS NERVES. — The nerves in the superficial fascia of the back of the leg are prolongations of branches already examined in part, viz. the internal and external saphenous, cutaneous offsets of the external popliteal, the small sciatic nerve, and offsets of the internal cutaneous of the thigh.

Internal saphenous in the leg. Termination. The *internal saphenous* nerve, which has been traced before to the knee (p. 681.), accompanies the vein of the same name in the leg, and terminates at the middle of the inner border of the foot. In the leg the nerve gives off lateral cutaneous offsets, and the outer of these turn over the tibia to the anterior aspect.

External saphenous ends on the foot; The *external saphenous* nerve is a branch of the internal popliteal (p. 708.); perforating the deep fascia about the middle of the leg, it is continued with the external saphenous vein below the outer ankle, and is distributed to the outer side of the foot and little toe.

branches to the leg. As soon as the nerve appears it is joined by the communicating branch of the external popliteal, and near the heel it gives large long branches to the integuments of that part.

Branches of the popliteal, communicating *Cutaneous nerves of the external popliteal.* — One branch of the external popliteal trunk (r. communicans fibularis, p. 709.) joins the external saphenous nerve, usually, about the middle of the leg*; but it is not uncommon to find this branch extend as a distinct nerve, unconnected with the other, as far as the heel. The other

and cutaneous. small *cutaneous* offsets of the external popliteal terminate over the outer side of the leg.

Termination of small sciatic. The *small sciatic* nerve perforates the fascia near the popliteal space, and reaches with the external saphenous vein to about the middle of the leg: it ramifies in the integuments, and joins the external saphenous nerve.

Termination of internal cutaneous. *Offsets of the internal cutaneous.* — Behind the internal saphenous nerve, near the knee, are the terminal branches of the inner division of the internal cutaneous nerve of the thigh (p. 680.); these

* Occasionally the junction may take place in or near the popliteal space.

extend to the middle, sometimes the lower third of the leg, and communicate with the internal saphenous nerve.

Dissection.—The deep fascia will be seen by removing the fat. The superficial vessels and nerves may be either cut or turned aside. Take away the fat.

The special or *deep fascia* on the posterior aspect of the leg covers the muscles, and sends a thick process between the deep and superficial layers. Above, it is continuous with the investing membrane of the thigh, and receives offsets from the tendons about the knee; below, it joins the internal annular ligament. Externally it is continued uninterruptedly from the one aspect of the limb to the other, but internally it is fixed to the edge of the tibia. Veins are transmitted through it from the deep to the superficial vessels. Deep fascia. Continuation and attachments.

Dissection.—The fascia is to be divided along the centre of the leg as far as the heel, and to be taken from the surface of the gastrocnemius muscle. By fixing with a stitch the inner head that has been cut, the cleaning the fibres of the muscle will be facilitated. Take away the fascia.

Superficial Layer of Muscles.—In the calf of the leg there are three muscles, gastrocnemius, soleus, and plantaris, which extend the ankle: the first two are large, and give rise to the prominence on the surface, but the last is inconsiderable in size and is chiefly tendinous. Muscles in superficial layer.

The gastrocnemius is the most superficial muscle. United below in the common tendon, it has above two distinct pieces or heads, which connect it with the condyles of the femur. The inner head of *origin* is attached by a large tendon to an impression at the posterior aspect of the inner condyle, behind the insertion of the adductor magnus, and by fleshy fibres to the line above the condyle. The outer head is fixed by tendon chiefly to a pit on the outer surface of the corresponding condyle, above the attachment of the popliteus muscle, and also to the upper and back part of the same condyle. These pieces are united along the middle line by a narrow tendinous slip, and terminate inferiorly with the soleus in the common tendon of insertion. One surface is covered by the fascia; the other is in contact with the soleus and the plantaris, and with the popliteal vessels and the internal popliteal nerve. The heads, by which the muscle arises, assist to form the lateral boundaries of the Gastrocnemius arises by two heads from the femur, ends below in tendo Achillis. Parts covered by it.

popliteal space: and the fleshy part of the inner descends lower than that of the outer. In the tendon of the outer head is a piece of fibro-cartilage, or a sesamoid bone.

Detach part of gastrocnemius. *Dissection.*—To see the soleus, the remaining head of the gastrocnemius is to be reflected by cutting across it, as well as the vessels and nerves it receives. After the muscle has been thrown down, the soleus and the plantaris must be cleaned.

Soleus is attached to the bones of the leg, and joins below the tendon. The SOLEUS is a large flat muscle, which is attached to both bones of the leg, and terminates, like the gastrocnemius, in the strong common tendon. It *arises* from the head, and the upper third or half of the posterior surface of the shaft of the fibula; from the oblique line across the tibia, and from the posterior edge of this bone in the middle third; and between the bones, from an aponeurotic arch over the large bloodvessels. Its fibres are directed downwards to the lower tendon. The superficial part of the soleus is in contact with the gastrocnemius; and the opposed surfaces of the two are aponeurotic. Beneath the muscle are the bones of the leg, the deep layer of flexors, and the vessels and nerves.

Tendo Achillis. Extent and insertion. The *common tendon* of the gastrocnemius and soleus (tendo Achillis) is the strongest in the body. It is wide above, and commences about the middle of the leg, though it receives fleshy fibres on the under surface nearly to the lower end: it is *inserted* by a narrow and rounded bundle into the lower part of the os calcis at the posterior aspect. A bursa intervenes between it and the upper part of the calcaneum. The tendon is close beneath the fascia; and lying along its outer side, but superficial to it, is the external saphenous vein.

Plantaris arises from the outer condyle, and joins common tendon. The PLANTARIS is remarkable in having the longest tendon in the body, which takes the appearance of a riband when it is stretched laterally. The fibres of the muscle *arise* from the line above the outer condyle of the femur, and from the posterior ligament of the knee joint, and soon end in the tendon which is *inserted* into the os calcis with or by the side of the tendo Achillis, or into the fascia of the leg. The belly of the muscle, which is about three inches in length, is concealed by the gastrocnemius, but the tendon appears on the inner side of the tendo Achillis about the

middle of the leg. This little muscle crosses the popliteal vessels, and lies on the soleus.

Dissection. — The soleus is to be detached from the bones of the leg, and the vessels and nerves it receives are to be divided; but in raising it the student should take care not to injure the deep fascia and the vessels and nerves. The superficial muscles may be next removed by cutting through their tendons near the os calcis. Detach soleus,

The piece of fascia between the muscles of the superficial and deep layer is then to be cleaned; and the integuments between the inner ankle and the heel are to be taken away to lay bare the annular ligament, but a cutaneous nerve to the sole of the foot in this spot is not to be destroyed. and clean the deep fascia.

Lastly the student should open the bursa between the tendo Achillis and the os calcis, if this has not been done.

Deep part of the fascia. — This intermuscular layer of the fascia of the leg is fixed to the tibia and fibula, and binds down the deep layer of flexor muscles. Beneath the soleus it is thin and indistinct; but below that muscle it is much stronger, and is marked by some transverse fibres near the malleoli, which give it the appearance and office of an annular ligament in that situation. Inferiorly it joins the annular ligament between the heel and the inner ankle. Deep part of the fascia of the leg.

Dissection. — The deep layer of muscles, and the trunks and offsets of the posterior tibial and peroneal vessels, and the posterior tibial nerve, will be made ready for examination by the removal of the fascia and the areolar tissue. A muscle between the bones (tibialis posticus) is partly concealed by an aponeurosis which gives origin to the muscles on its sides, and will not fully appear till after this has been divided. Clean the deep muscles.

Deep layer of muscles. — The deep flexor muscles at the back of the leg are four in number, viz. popliteus, flexor longus pollicis, flexor longus digitorum, and tibialis posticus. The first of these is close to the knee joint; it crosses the bones, and is covered by a special aponeurosis. The flexors lie on the bones, that of the great toe being on the fibula, and that of the other toes on the tibia. And the last muscle covers the interosseous membrane. With the exception of the popliteus, all enter the sole of the foot, and have a fleshy Four muscles in the deep layer. Position and destination.

part parallel to the bones of the leg, and a tendinous part beneath the tarsus.

Popliteus arises within knee joint.

The POPLITEUS arises within the capsule of the knee joint; it is attached by a tendon to the fore part of an oblong depression on the outer surface of the external condyle of the femur, below the external lateral ligament. External to the capsule of the joint some fleshy fibres arise from the posterior ligament, and the tendon gives origin to other fibres which radiate from it; all are *inserted* into the tibia above the oblique line on the posterior surface. The muscle lies on the tibia, and is covered by a fascia, derived in great part from the tendon of the semimembranosus muscle. On it lie the popliteal vessels and nerve, with the gastrocnemius and plantaris. Along the upper border are the lower articular vessels and nerve of the inner side of the knee. The insertion of the muscle corresponds with the attachment of the soleus on the tibia; and the origin will be seen with the dissection of the ligaments of the knee joint.

Inserted into tibia.

Parts around it.

Flexor longus pollicis is attached to fibula,

The FLEXOR LONGUS POLLICIS PEDIS arises below the soleus from the lower half or two thirds of the posterior surface of the fibula except an inch inferiorly, from the intermuscular septum between it and the peronei muscles, and from the aponeurosis over the tibialis. Inferiorly the tendon of the muscle enters a groove in the astragalus, and afterwards crosses the sole of the foot to reach the great toe. In part the muscle is covered by the soleus; but in part it is superficial, and is in contact with the fascia. It rests on the fibula and the lower end of the tibia, and conceals the peroneal vessels. Along the inner side are the posterior tibial nerve and vessels; and contiguous to the outer margin, but separated by the fascia, are the peronei muscles.

is partly superficial.

Muscles and vessels on sides.

Flexor longus digitorum lies on tibia;

The FLEXOR LONGUS DIGITORUM PEDIS (flexor perforans) is attached to the posterior surface of the tibia, extending from the popliteus to about three inches from the lower extremity, and it takes origin also from the aponeurosis covering the tibialis posticus. Its tendon enters a partition in the annular ligament, which is superficial in this position to the sheath of the tibialis; and escaped from the ligament divides in the sole of the foot into tendons for the four outer toes. The muscle is narrow and pointed superiorly and is placed beneath the soleus; but in the lower half it is in con-

in the ligament;

part is superficial

tact with the fascia, and the posterior tibial nerve and vessels lie on it. The deep surface rests on the tibia and the tibialis posticus.

below soleus.

The TIBIALIS POSTICUS occupies superiorly the interval between the bones of the leg, but it crosses inferiorly beneath the long flexor of the toes to reach the inner side of the foot. The muscle *arises* from the aponeurosis covering it, and from the posterior surface of the interosseous membrane, except about two inches below; from an impression along the outer border of the tibia, contiguous to the interosseous membrane, which reaches from the head of the bone to rather beyond the lower attachment of the flexor longus digitorum; and from the adjacent inner surface of the fibula for the middle three fifths of its length. In the lower fourth of the leg this muscle is directed beneath the flexor digitorum; and its tendon entering the inner space in the annular ligament, reaches the inner side of the foot to be inserted into the scaphoid and other bones. The tibialis is concealed by the aponeurosis before mentioned, and is overlapped by the neighbouring muscles, but in the lower fourth of the leg it is placed between the tibia and the long flexor of the toes. On the muscle are the posterior tibial vessels and nerve. The upper part presents two pointed processes of attachment to the bones — that to the tibia being the highest, between which the anterior tibial vessels are directed forwards.

Tibialis covers interosseous membrane,

crosses beneath the flexor of the toes.

Muscles and vessels in connection with it.

The *aponeurosis* covering the tibialis is attached laterally to the bones, but has a defined border inferiorly over the muscle. By one surface it gives origin to the flexors of the toes, and by the other to the tibialis.

The muscle covered by an aponeurosis.

The POSTERIOR TIBIAL ARTERY is one of the branches resulting from the bifurcation of the popliteal trunk. The artery extends from the lower border of the popliteus muscle to the lower part of the internal annular ligament, where it ends in two plantar branches for the sole of the foot. At its origin the artery lies midway between the tibia and fibula, but as it approaches the lower part of the leg it gradually inclines inwards; and at its termination it is placed below the tibia, in the centre of the hollow between the heel and the inner ankle.

Posterior tibial artery.

Extent.

Course.

As far as the middle (in length) of the leg the vessel is

Parts covering

the upper and lower half. concealed by two muscles of the calf, viz. the gastrocnemius and soleus; but below that spot, as it lies between the tendo Achillis and the inner edge of the tibia, it is covered only by the integuments and the deep fascia. At its termination it is beneath the annular ligament. For the greatest part of its extent the arterial trunk lies over the tibialis posticus, but afterwards on the flexor digitorum, and on the lower end of the tibia and the ankle joint.

Parts beneath it.

Veins. Venæ comites (posterior tibial veins) closely surround the vessel. The posterior tibial nerve is at first internal to the artery, but at the distance of one inch and a half it crosses to the outer side, and retains that position throughout.

Nerve.

Branches. This artery supplies *branches* to the muscles and the tibia, and a large peroneal trunk to the outer side of the leg.

Muscular. *Muscular branches* enter the deep layer of muscles and the soleus; an offset from a branch to the latter muscle pierces the fleshy attachment to the tibia, and ascends to the knee joint.

Nutritious to tibia. A *nutritious* artery of the tibia is uncertain in its place of origin: passing through the tibialis, it enters the canal on the posterior surface of the bone, and ramifies in the interior.

Communicating. A *communicating* branch to the peroneal arises opposite the lower end of the tibia, and passes outwards beneath the flexor pollicis, to unite in an arch with a corresponding offset of the peroneal artery.

Peroneal artery The *peroneal artery* is often as large as the posterior tibial, and arises from that vessel about one inch and a half from the beginning. It takes the fibula as its guide, and lying close to the bone in the fibres of the flexor pollicis, reaches the lower part of the interosseous membrane. At this spot it sends forwards a branch to the front of the leg (anterior peroneal), and continues over the articulation between the tibia and fibula to the outer side of the foot, where it terminates in branches, and anastomoses with the tarsal and external plantar arteries. Two companion veins surround the artery.

is contained in flexor pollicis.

Termination.

Branches. *Branches.*—Besides the anterior peroneal, it furnishes muscular, nutritious, and communicating offsets.

Muscular. *Muscular* branches are distributed to the soleus and the deep flexors, and some turn round the fibula to the peronei muscles.

Nutritious to fibula The *nutritious* artery is smaller than that to the tibia, and is transmitted through the tibialis posticus to the aperture about the middle of the fibula.

The *anterior peroneal* branch passes forwards through an aperture in the lower part of the interosseous membrane, and is directed in front of the fibula to the dorsum and the outer part of the foot: on the front of the leg and foot it anastomoses with the external malleolar and tarsal branches of the anterior tibial artery. Anterior peroneal to front of foot.

A *communicating* offset near the ankle joint joins in an arch, as before mentioned, with a similar branch of the posterior tibial; sometimes there is a second arch between the same vessels. Communicating.

Peculiarities in the arteries. — The *posterior tibial artery* may be smaller than usual, or absent; its place will then be supplied below in the foot by a large peroneal artery, which will be directed inwards at the lower end of the tibia, and either join the small tibial vessel, or run alone to the sole of the foot. Size of tibial changes.

The *peroneal artery* may arise from the popliteal, or from the anterior tibial artery. And its anterior peroneal branch may take the place of the anterior tibial artery on the dorsum of the foot. Origin and ending of peroneal vary.

A compensating principle may be observed amongst the arteries of the foot as in those of the hand, by means of which the deficiency in one is supplied by an enlarged offset of another. Substitutions.

The *posterior tibial veins* begin on the inner side of the foot by the union of the plantar veins: they ascend, one on each side of their artery, and unite with the anterior tibial trunks at the lower border of the popliteus, to form the large popliteal vein. They receive the peroneal veins, and branches corresponding with the offsets of the artery: branches connect them also with the saphenous veins. Posterior tibial veins.

The *posterior tibial nerve* is a continuation of the internal popliteal, and reaches, like the artery, from the lower border of the popliteus muscle to the interval between the os calcis and the inner malleolus. Whilst beneath the annular ligament or somewhat higher than it, the nerve divides into the internal and external plantar branches of the foot. Its connections with surrounding parts are the same as those of the artery; but its position to the vessel changes, for it lies on the inner side of the posterior tibial artery above the origin of the peroneal offset, but on the outer side thence to the termination. Its lateral branches are chiefly muscular. Posterior tibial nerve. Extent and connections. Position to the artery. Branches.

Muscular branches enter the deep flexors, and arise either at separate points along the trunk, or together from the internal popliteal nerve. There is an offset for each muscle, except the popliteus, but the branch for the tibialis is the largest, and that for the flexor pollicis lies on the peroneal artery. Muscular to the deep flexors.

Cutaneous of the foot. A *cutaneous nerve* of the *sole* of the *foot* pierces the internal annular ligament, and ends in the integument of the inner and under part of the heel; this nerve will be followed to its termination in the dissection of the foot.

Internal annular ligament. The *internal annular ligament* is placed between the heel and the inner ankle, and serves to confine the tendons of the deep flexor muscles of the foot and toes. Attachments. Attached by a pointed part to the internal malleolus, the fibres diverge from it, and are inserted into the os calcis. One border (upper) is continuous with the fascia of the leg; and the opposite gives attachment to the abductor pollicis muscle of the foot. Processes of it separate the tendons, forming sheaths; Beneath it are sheaths for the tendons, which are formed by the fascia stretched over the subjacent osseous grooves. When the sheaths are opened, the innermost will be found to contain the tibialis posticus, which is lodged their position; in a groove in the malleolus: immediately behind this is another space for the flexor digitorum; and about three quarters of an inch nearer the os calcis, is the interval in lined by synovial membrane. which the flexor pollicis lies, contained in a groove in the astragalus. Each sheath is lined by a synovial membrane.

Tibial vessels and nerve beneath the ligament. *Vessels beneath the ligament.* — The posterior tibial vessels in passing beneath the ligament lie between the tendons of the flexor pollicis and flexor digitorum, but rather nearer the latter. The artery supplies here small *offsets* to the tarsus, and the ankle joint. Occasionally the artery divides beneath or even above the ligament. The nerve is nearer than the artery to the os calcis; but it is sometimes bifurcated beneath the ligament, so that a nerve may lie on each side of the tibial vessels.

Section V.

THE SOLE OF THE FOOT.

Position of the part. *Position.* — The foot is to be placed over a block of some thickness with the sole towards the dissector, and the part is to be made tense by fastening down, and separating the toes.

Raise the skin *Dissection.* — The skin is to be raised as two flaps, inner and outer, by means of one incision along the centre of the sole from the heel to the anterior part, and by another across the foot at the root of the toes. Afterwards the skin is to be removed from each toe, and the lateral digital vessels and

nerves are to be dissected out at the same time. In the fat near the heel the student should follow the cutaneous nerve of the sole of the foot (p. 724.), and trace out, at a little distance from each border of the foot, some small branches of the plantar nerves and arteries. and dissect cutaneous nerves.

The *subcutaneous fat* of the sole of the foot is very abundant, and forms the thickest cushion over the parts of the surface that press most on the ground in standing, viz. over the os calcis, and the line of the metatarso-phalangeal articulations. Subcutaneous fat.

Dissection. — The fat should be now removed, and the plantar fascia laid bare. Begin the dissection near the heel, and follow forwards the fascia towards the toes, to each of which a process is to be traced. In the intervals between these processes the digital nerves and arteries will be found covered by much fatty and fibrous tissues; but the vessels and nerves to the inner side of the great toe, and the outer side of the little toe, pierce the fascia farther back than the rest. Lay bare the plantar fascia, and the digital vessels and nerves.

The student is next to dissect a transverse fibrous band between the toes, over the digital vessels and nerves; and when this has been defined, to remove the superficial fascia from the toes to see the sheaths of the tendons. Define the ligament of the toes.

Plantar fascia. — The special fascia of the sole of the foot is of a pearly white colour and great strength, and sends septa between the muscles. Its thickness varies in different parts of the foot; and from this circumstance, and from the existence of longitudinal depressions where the two chief intermuscular septa are attached, the fascia is divided into a central and two lateral parts. Plantar fascia. Division into parts.

The central part, which is much the thickest, is pointed at its attachment to the os calcis, but widens and becomes thinner as it extends forwards. A slight depression, corresponding with an intermuscular septum, marks its limit on each side. Opposite the heads of the metatarsal bones it divides into five processes, which send bands to the integument near the web of the foot, and are then continued onwards to the toes, one to each. If one of the processes be divided longitudinally, and its parts reflected to the sides, it will be seen to join, at the centre, the sheath of the flexor tendons, whilst it is attached on the sides to the margins of the metatarsal bone, and to the ligament uniting one of Central part divides into five pieces. Termination of the pieces.

Arched fibres over vessels. these bones to another. Where the processes separate from each other, the digital vessels and nerves and the lumbricales muscles become superficial, and transverse fibres arch over the intervals between them.

Inner part of the fascia; The lateral parts of the fascia are thinner than the central piece. On the inner margin of the foot the fascia has but little strength, and is continued to the dorsum; but on the outer part. outer side it is increased in thickness, and presents a strong band between the os calcis and the projection of the fifth metatarsal bone.

Expose the septa. *Dissection.* — To examine the septa, a longitudinal incision may be made along the centre of the foot, and a transverse one near the calcaneum. On detaching the fascia from the subjacent flexor brevis digitorum, by carrying the scalpel from before backwards, the septal processes will appear on the sides of that muscle.

Two intermuscular septa; inner The *intermuscular septa* pass down on the sides of the flexor brevis digitorum, and thus isolate the central muscle in the superficial layer of the sole of the foot. The inner one lies between the short flexor and the abductor pollicis, and is perforated by the internal plantar nerve, and by the and outer. tendon of the flexor pollicis longus. The outer one, between the short flexor and the abductor minimi digiti, is pierced by the digital nerve and artery for the outer side of the little toe. A piece of fascia reaches across the foot from the one septum to the other, beneath the short flexor.

Transverse ligament of the toes. The *transverse ligament* crosses the roots of the toes, and is contained in the skin forming the rudimentary web of the foot. It is a band of fibres which is attached at the extremities to the great and little toes, and is connected with each of the others, as it passes over. Beneath it are the digital nerves and vessels.

Sheaths of flexor tendons. The *sheaths* of the *flexor tendons* are similar to those of the fingers, though not so distinct, and serve to confine the tendons against the grooved bones. The sheath is weak opposite the articulations between the phalanges, but is strengthened by a band opposite the centre of both the metatarsal and the next phalanx. Each is lubricated by a synovial membrane, and contains tendons of the long and short flexor muscles.

Dissect *Dissection.* — In the sole of the foot the muscles are

numerous, and have been arranged in four layers. To prepare the first layer all the fascia must be taken away, but this dissection must be made with some care, lest the digital branches of the plantar nerves, which become superficial to the muscles towards the toes, should be injured. The tendons of the short flexor muscle are to be followed to the toes, and the sheaths in which they are contained must be opened. First layer of muscles.

FIRST LAYER OF MUSCLES.— In the first layer which is now visible, are three muscles, viz. the flexor brevis digitorum, the abductor pollicis, and abductor minimi digiti: the short flexor of the toes is in the centre of the foot, and each of the others is in a line with the toe on which it acts. Muscles are in four layers; three muscles in the first.

The ABDUCTOR POLLICIS is the most internal of the muscles of the superficial layer. It takes *origin* from the inner part of the larger tubercle on the under surface of the os calcis; from the internal annular ligament, and the fibrous structures on the inner side of the foot as far as the internal cuneiform bone; and from the plantar fascia. In front the muscle ends in a tendon, which is joined by fibres of the short flexor of the great toe, and is *inserted*, with the tendon of that flexor, into the inner side of the base of the metatarsal phalanx of the great toe. The cutaneous surface of the muscle is in contact with the plantar fascia; and the other touches the plantar vessels and nerves, the tendons of the long flexors of the toes, and the accessory muscle. Abductor pollicis; origin; insertion; connections.

The FLEXOR BREVIS DIGITORUM (flexor perforatus) *arises* posteriorly by a pointed tendinous process from the inner part of the larger tubercle of the os calcis, and by fleshy fibres from the plantar fascia and its septa. About the centre of the foot the muscle ends in four small tendons; these are directed forwards over the tendons of the long flexor, and entering the sheaths of the four smaller toes, are *inserted* into the middle phalanges. In the sheath of the toe, the tendon of this muscle lies at first (in this position) on that of the long flexor; but opposite the middle of the metatarsal phalanx it is slit for the passage of the other, and is attached by two processes to the sides of the middle phalanx. The short flexor of the toes is contained in a sheath of the plantar fascia, and occupies the middle of the foot: it conceals the tendon of the long flexor of the toes, the accessory muscle, and the external plantar vessels and nerve. Flexor brevis digitorum divides into tendons for the toes; these are slit. Connections.

Abductor of the little toe. The ABDUCTOR MINIMI DIGITI has a wide *origin* behind from the outer and inner tubercles of the os calcis, and from the plantar fascia and the external intermuscular septum. Origin and insertion. It ends anteriorly in a tendon which is *inserted*, with the short flexor of the little toe, into the outer side of the base of the metatarsal phalanx of that toe. The muscle lies along Is at side of the foot. the outer border of the foot, and conceals the flexor accessorius, and the tendon of the peroneus longus. On its inner side are the external plantar vessels and nerve.

Dissect plantar vessels and nerves. *Dissection.* — To bring into view the second layer of muscles and the plantar vessels and nerves, the muscles already examined must be reflected. Cut through the flexor brevis at the os calcis, and as it is raised, notice a branch of nerve and artery to it; divide the abductor minimi digiti near its origin, and turning it to the outer side of the foot, seek a small nerve and vessel to it close to the bone. The abductor pollicis can be drawn aside if it is necessary, but it may remain uncut till afterwards. Now the plantar vessels and nerves are to be followed forwards to their termination, and backwards to their origin; and the tendons of the long flexors of the toes, the accessory muscle, and the small lumbricales, should be freed from loose tissue.

Two plantar arteries: The PLANTAR ARTERIES are the terminal branches of the posterior tibial trunk. They are two in number, and are named external and internal from their relative position in inner and outer. the sole of the foot. Of the two the external is the larger; and it forms the plantar arch of arteries, from which digital branches are furnished to the toes.

internal small; The *internal* artery is commonly inconsiderable in size, and is directed forwards, under cover of the abductor pollicis, ends on side of the foot. to the root of the great toe: here it ends either in small branches to the side of the foot, or in digital branches to the inner two toes which anastomose with the external plantar artery.

External artery has curved course; The *external* artery has an arched course in the foot, with the concavity of the arch turned inwards, and supplies branches to the toes. Starting from the inner part of the foot, the vessel is first directed outwards across the sole, and then obliquely forwards towards the root of the great toe, or to the side on which it began, so that the vessel crosses twice the foot. In the first half of its extent, the artery is com-

paratively superficial, and extends from the inner side of the calcaneum to the base of the metatarsal bone of the little toe; in the other half it lies deeply in the foot, in contact with the interosseous muscles, and forms the plantar arch between the little and the great toe. partly superficial, partly deep.

Only the first part of the artery is now laid bare; the remaining part, that supplying the digital branches, will be noticed after the examination of the third layer of muscles (p. 733.). As far as the metatarsal bone of the little toe, the vessel is concealed by the abductor pollicis and the flexor brevis digitorum, but for a short distance near its termination it lies in the interval between the last muscle and the abductor minimi digiti. In this extent it is placed on the os calcis, and the flexor accessorius; and it is accompanied by venæ comites, and the external plantar nerve. It supplies offsets to the muscles between which it lies, and some branches to the outer side of the foot for anastomosis with the peroneal artery. Superficial part. Connections. Veins and nerve. Branches.

The PLANTAR NERVES are derived from the bifurcation of the posterior tibial nerve behind the inner ankle. They are two in number, like the arteries, and have the same connections as those vessels, for each accompanies a plantar artery; but the larger nerve is found with the smaller bloodvessel. Plantar nerves also two, but the inner is largest.

The *internal plantar* nerve courses with its artery between the short flexor and the abductor pollicis, and divides into four digital branches for the supply of both sides of the inner three toes, and half the fourth; it thus resembles the median nerve in the hand in the number and distribution of its digital branches. Offsets are given by it to the short flexor and the abductor pollicis, and a few superficial twigs perforate the fascia. Internal nerve to three toes and a half. Other branches.

The *digital* nerves have a numerical designation, and the first is nearest the inner border of the foot. The branch to the inner side of the great toe is undivided, but the others are bifurcated at the clefts between the toes. Muscular branches are furnished by the nerves before they reach the toes; thus, the first (most internal) supplies the flexor brevis pollicis; the second, the inner lumbrical muscle; and the third, the next lumbrical muscle. Digital nerves are divided except first; muscular branches;

On the toes. — Each of the outer three nerves, being give cutaneous

divided at the spot mentioned, supplies cutaneous offsets to the contiguous sides of two toes, and to the cutis beneath the nail; and articular filaments are distributed to the joints, as in the fingers.

and articular offsets.

External nerve to one toe and a half;

The *external plantar* nerve furnishes the remaining digital nerves, viz. to both sides of the little toe, and the outer side of the next, and ends in the deep muscles of the sole of the foot. This nerve corresponds in its arrangement with the ulnar nerve in the hand. It has the same course as the external plantar artery, and divides at the outer margin of the flexor brevis digitorum into a superficial and a deep portion: — the former gives origin to two digital nerves; but the latter accompanies the arch of the plantar artery into the foot, and will be afterwards dissected. Whilst the external plantar nerve is concealed by the short flexor of the toes, it gives muscular branches to the abductor minimi digiti and the flexor accessorius.

has superficial and deep parts.

Branches.

Two digital branches from superficial part.

The *digital branches* of the external plantar nerve are but two, and resemble those of the ulnar nerve in the hand. One is undivided; it is distributed to the outer side of the little toe, and gives branches to the flexor brevis minimi digiti, and the interosseous muscles of the fourth space. The other bifurcates at the cleft between the outer two toes, and supplies their collateral surfaces: this nerve communicates in the foot with the last digital branch of the internal plantar nerve.

One is undivided.

Distribution like others.

On the toes. — On the sides of the toes the digital nerves have the same distribution as those from the other plantar trunk.

Lay bare second layer of muscles.

Dissection.— To complete the preparation of the second layer of muscles, the origin of the abductor pollicis should be detached from the os calcis, and the muscle should be turned inwards. The internal plantar nerve and artery, and the superficial portion of the external plantar nerve, are to be cut across and thrown forwards; but the external plantar artery and the nerve with it are not to be injured. All the fat and loose tissue and the fascia are to be taken away from near the toes.

Tendons and muscles of the second layer.

SECOND LAYER OF MUSCLES.—In this layer are the tendons of the two flexor muscles at the back of the leg, viz. the flexor longus digitorum and flexor longus pollicis, which

cross one another: connected with the former, soon after it enters the foot, is an accessory muscular slip, and at its division into pieces are four slender muscles named lumbricales.

The tendon of the FLEXOR LONGUS DIGITORUM, whilst entering the foot beneath the annular ligament, lies on the internal lateral ligament of the ankle joint. In the foot it is directed obliquely towards the centre of the sole, where it is joined by the tendon of the flexor longus pollicis and the accessory muscle, and divides into tendons for the outer four toes. Each tendon enters the sheath of the toe with, and beneath a tendon from the flexor brevis. About the centre of the metatarsal phalanx the tendon of the long flexor is transmitted through the other, and passes onwards to be *inserted* into the base of the ungual phalanx.* The tendon of the flexor longus digitorum is sometimes increased in size by its junction with that of the long flexor of the great toe.

Tendon of the flexor of the toes

divides into four.

These enter the sheaths of the outer toes and pierce the other tendons.

The *lumbricales* are four small muscles between the tendons of the flexor longus digitorum. Each *arises* from two tendons, with the exception of the most internal; and this last is connected with the inner side of the tendon to the second toe. Each is *inserted* into the tibial side of the base of the metatarsal phalanx in the outer four toes; and from the insertion an expansion is prolonged to the dorsum of the phalanx to join the aponeurotic covering on it. These muscles decrease in size from the inner to the outer side of the foot.

Four lumbricales.

Attachment to toes and long flexor.

The *accessorius muscle* has two heads of origin: — one is tendinous, and is attached to the under or the outer surface of the os calcis, and the ligamentum longum plantæ; the other is large and fleshy, and springs from the inner or concave surface of the calcaneum. The fibres end in aponeurotic bands, which join the tendon of the flexor longus digitorum about the centre of the foot, so as to form a kind of groove for it. The muscle is bifurcated behind, and the heads of origin are separated by the long plantar ligament. On it are the external plantar vessels and nerve, and the flexor brevis digitorum conceals it.

Flexor accessorius

is joined with flexor longus.

* In the foot there are ligamentous bands to the flexor tendons as in the hand, and the one fixing the flexor perforans is provided also with elastic tissue. See p. 314.

Insertion of tendon of flexor pollicis. The tendon of the FLEXOR LONGUS POLLICIS is deeper in the sole of the foot than that of the flexor longus digitorum, to which it is united by a strong tendinous process: it is then directed to the root of the great toe, enters the digital sheath, and is *inserted* into the base of the ungual phalanx. Between the calcaneum and the internal malleolus this tendon lies in a groove in the astragalus; and in the foot, in a groove below the inner projection (sustentaculum tali) of the os calcis.

Dissect third layer of muscles. *Dissection.*—For the dissection of the third layer of muscles, the accessorius and the tendons of the long flexor are to be cut through near the calcaneum, and turned towards the toes; whilst raising the tendons the external plantar nerve and artery are not to be interfered with, and two small nerves to the external two lumbricales are to be looked for. Afterwards the areolar tissue is to be taken from the muscles now brought into view.

Third layer of muscles. THIRD LAYER OF MUSCLES.—Only the short muscles of the great and little toes enter into this layer. On the metatarsal bone of the great toe the flexor brevis pollicis lies, and external to it is the adductor pollicis; on the metatarsal bone Position. of the little toe is the flexor brevis minimi digiti. Crossing the heads of the metatarsal bones is the transversalis pedis muscle. The fleshy mass between the adductor pollicis and the short flexor of the little toe consists of the interossei muscles of the next layer.

Flexor brevis pollicis is bifurcated before and joins other muscles. The FLEXOR BREVIS POLLICIS muscle is tendinous and pointed at the posterior part, but bifurcated in front. It is attached posteriorly to the inner border of the cuboid bone, and to a prolongation from the tendon of the tibialis posticus to the outer two cuneiform bones. Near the front of the metatarsal bone of the great toe it divides into two heads, which are inserted into the sides of the base of the metatarsal phalanx. Resting on the muscle, and in the interval between the heads, is the tendon of the flexor longus pollicis. The inner head joins the abductor, and the outer is united with the adductor pollicis. A sesamoid bone is developed in the tendon connected with each head.

Adductor pollicis The ADDUCTOR POLLICIS, which is larger than the preceding muscle, and external to it, arises from the sheath of the tendon of the peroneus longus, and from the bases of the

third and fourth metatarsal bones. Anteriorly the muscle is united with the outer head of the short flexor, and is inserted with it into the base of the metatarsal phalanx of the great toe. To the inner side is the flexor brevis; and beneath the outer border the external plantar artery and nerve are directed inwards.

joins outer head of short flexor.

Covers plantar arch.

The TRANSVERSALIS PEDIS is placed transversely over the heads of the metatarsal bones. Its origin is by fleshy bundles from the four outer bones and their phalangeal articulations (frequently not from the little toe); and its insertion is united with that of the adductor pollicis. The cutaneous surface is covered by the tendons, and the vessels and nerves of the toes; and the opposite surface is in contact with the interossei muscles. This muscle is sometimes described as a part of the adductor pollicis.

Transversalis pedis

attached to ends of the toes.

The FLEXOR BREVIS MINIMI DIGITI is a small narrow muscle; it lies on the metatarsal bone of the little toe, and resembles one of the interossei. Attached to the metatarsal bone, and slightly to the sheath of the peroneus longus, it is *inserted* into the outer side of the base of the metatarsal phalanx of the same toe, and into the inferior ligament of the metatarso-phalangeal articulation.

Flexor minimi digiti is like an interosseous.

Dissection. — In order that the deep vessels and nerves may be seen, the flexor brevis and adductor pollicis are to be cut through at their posterior part, and thrown towards the toes, but the nerves supplying them are to be preserved. Beneath the adductor is the plantar arch, and the external plantar nerve, with their branches; and in the first interosseous space is the part of the dorsal artery of the foot that enters the sole. All these vessels and nerves require careful cleaning. The muscles projecting between the metatarsal bones are the interossei.

Dissect the deep vessels and nerves.

The *plantar arch* is the part of the external plantar artery that extends obliquely from the base of the metatarsal bone of the little toe to the back of the first interosseous space (p. 728.): internally the arch is completed by a communicating branch from the dorsal artery of the foot. It is placed across the tarsal ends of the metatarsal bones in contact with the interossei, being between the third and fourth layers of muscles in the foot. From the front or convexity of the arch the digital branches are supplied, and from the opposite

Arch of the plantar artery.

Extent and connections with muscles.

Branches.

side small muscular branches arise. From the under part are given off three small arteries, the *posterior perforating*; these pass to the dorsum of the foot through the outer three intermetatarsal spaces, and anastomose with the interosseous branches of the anterior tibial artery.

Posterior perforating.

Digital branches to three outer toes and half the next.

The *digital branches* are four in number, and supply both sides of the outer three toes, and half of the next. The one to the outer side of the little toe is single; the others lie in the outer three metatarsal spaces, and bifurcate in front to supply the contiguous sides of two toes. Where they divide, they send small communicating branches — *anterior perforating*, to the interosseous arteries on the dorsum of the foot.

Anterior perforating offsets.

Distribution.

On the toes. — On the sides of the toes the disposition of the arteries is like that in the hand: — they extend to the last phalanx, where they unite in an arch, and give offsets to the ball of the toe; and near the front of both the metatarsal and the next phalanx, they form anastomotic loops beneath the tendons, from which the phalangeal articulations are supplied.

Ending of the dorsal artery of the foot;

The *dorsal artery of the foot* enters the sole at the posterior part of the first (inner) intermetatarsal space, and supplies digital offsets to both sides of the great toe and to half the next, in the same manner as the radial artery in the hand is distributed to one digit and a half. Besides these, it furnishes a communicating branch to join the plantar arch.

its digital branch,

The *digital branch* (art. magna pollicis) extends to the front of the first interosseous space, and divides into collateral branches for the great toe and the next. Near the front of the metatarsal bone it sends inwards previously, beneath the flexor muscles, the digital branch for the inner side of the great toe.

on the digits.

These arteries have the same arrangement along the toes as the other digital branches.

External plantar nerve ends in the deep muscles.

The *deep branch* of the *external plantar nerve* passes with the arch of the artery, and ends internally in the adductor pollicis. It furnishes branches to all the interossei, one or both in the external space excepted; to the transversalis pedis; and to the external two lumbrical muscles.

Dissection.

Dissection. — It will be needful to remove the transver-

salis pedis muscle, to see a ligamentous band across the heads of the metatarsal bones.

The *transverse metatarsal ligament* is a strong fibrous band, like that in the hand (p. 318.), which connects together the anterior extremities of all the metatarsal bones. A thin fascia covering the interossei muscles is connected to its hinder part. It is concealed by the transversalis pedis, and by the tendons, vessels, and nerves of the toes. Transverse metatarsal ligament.

Dissection. — To complete the dissection of the last layer of muscles, the flexor brevis minimi digiti may be detached and thrown forwards. Then the metatarsal ligament is to be divided between the bones, the knife being carried directly backwards in the centre of each interosseous space except the first, in order that the two interossei muscles may be separated one from another. The fascia covering these muscles should be taken away, and the branches of the external plantar nerve to them are to be dissected out. All the interossei are visible in the sole of the foot. Dissect the last layer of the muscles.

FOURTH LAYER OF MUSCLES.—In the fourth and last layer of the foot are contained the interossei muscles, and the tendons of the tibialis posticus and peroneus longus muscles. Fourth layer of muscles.

The INTEROSSEI MUSCLES are situate in the intervals between the metatarsal bones: their arrangement corresponds closely with that of the interossei in the hand, consisting like these of two sets, plantar and dorsal. Seven in number, there are three plantar and four dorsal; and two are found in each space, except in the internal one. Interossei, are plantar and dorsal.

The *plantar interossei* belong to the outer three metatarsal bones: they arise from the under and inner surfaces of those bones, and are inserted into the tibial side of the base of the metatarsal phalanx of the same toes; and an expansion is continued from each to the extensor tendon on the dorsum of the phalanx. These muscles are smaller than the dorsal, and are placed more in the sole of the foot. Three plantar for three outer toes.

The *dorsal interossei*, one in each space, arise from the lateral surfaces of the two bones between which they lie, and are inserted into a particular side of the metatarsal phalanx of certain toes:—Thus, the internal two muscles are attached to the second toe, one to each side; the next to the outer side of the third toe, and the remaining one to the outer side of the fourth toe. An expansion is continued from the Four dorsal lie between the bones;

toes inserted into. tendons to those of the extensors on the dorsum of the phalanges; and the posterior perforating arteries pierce the hinder extremities of the muscles. These small muscles will be partly seen on the dorsum of the foot.

Action of the muscles. The attachment of the dorsal muscles to the toes may be remembered by considering them abductors as in the hand (p. 319.) from the middle line of the second digit: the outer two muscles will draw their respective toes from the rest, and the two connected with the second digit will move it to the right or the left of the line referred to.

Trace out the deep tendons. *Dissection.* — Follow the tendon of the tibialis posticus muscle from its position behind the inner malleolus to its insertion into the scaphoid bone, and trace the numerous processes that it sends forwards and outwards. Open also the fibrous sheath of the tendon of the peroneus longus, which crosses from the outer to the inner side of the foot.

Insertion of tendon of tibialis posticus. The tendon of the TIBIALIS POSTICUS, after leaving the groove in the inner malleolus, is continued forwards over the internal lateral ligament of the ankle joint, and over the articulation between the astragalus and the os scaphoides, and is inserted into the prominence of the latter bone. From its insertion processes are continued to many of the other bones of the foot. One is directed backwards to the margin of the groove in the os calcis for the tendon of the flexor longus pollicis. Two offsets are directed forwards: — one is prolonged to the internal cuneiform bone; the other, much the largest, is attached to the middle and outer cuneiform, to the os cuboides, and to the bases of the second, third, and fourth metatarsal bones. Where the tendon is placed beneath the articulation of the astragalus, it contains a sesamoid bone, or a fibro-cartilage.

Insertion of tendon of peroneus longus. The tendon of the PERONEUS LONGUS MUSCLE turns round the cuboid bone, and placed in the groove on the under surface, is continued inwards to be inserted into the internal cuneiform bone, and the base of the metatarsal bone of the great toe; it sends a process also to the base of the second metatarsal bone. In the sole of the foot it is contained in a sheath which is formed, for the most part, by the fibres of the long plantar ligament prolonged to the tarsal ends of the third and fourth metatarsal bones. A separate synovial membrane lubricates the sheath. Where the tendon turns

round the cuboid bone it is thickened, and contains fibro-cartilage or a sesamoid bone.

Section VI.

THE FRONT OF THE LEG.

Position.— The limb is to be raised to a convenient height by blocks placed beneath the knee, and the foot is to be extended in order that the muscles on the front of the leg may be put on the stretch. Position of the limb.

Dissection.— To enable the dissector to raise the skin from the leg and foot, one incision should be made along the middle line, from the knee to the toes, and this should be intersected by cross cuts at the ankle and the web of the foot. Raise the skin.

After the flaps of skin are reflected, the cutaneous vessels and nerves are to be looked for. At the inner part of the leg are some filaments from the great saphenous nerve, and at the outer side, others from the cutaneous ramifications of the external popliteal nerve. Perforating the fascia in the lower third, on the anterior aspect, is the musculo-cutaneous nerve, whose branches should be pursued to the toes. Seek the cutaneous nerves in the leg;

On the dorsum of the foot is an arch of veins, which ends at the sides in the saphenous veins. On the outer side is the short saphenous nerve; and in the interval between the great toe and the next, is the cutaneous part of the anterior tibial nerve. The nerves should be traced to the ends of the toes by removing the integuments. on the foot both vessels and nerves.

After the several vessels and nerves are dissected, the fat is to be taken away, in order that the fascia may be seen.

The *venous arch on the dorsum of the foot* has its convexity turned forwards, and receives digital branches from the toes; at its concavity it is joined by small veins from the instep. Internally and externally it joins the saphenous veins. Cutaneous veins.

The *internal saphenous vein* begins at the inner side of the great toe, and in the arch of veins; it ascends along the inner side of the foot, and in front of the inner ankle to the inner part of the leg, where it has been before seen (659.). It receives branches from the inner side and the sole of the foot. Internal saphenous.

External saphenous. The *external saphenous vein* begins on the outside of the little toe and the foot, as well as in the venous arch; it is then continued below the outer ankle to the back of the leg (p. 716.).

Source of the cutaneous nerves. Cutaneous Nerves. — All the superficial nerves on the front of the leg and foot are derived from branches of the popliteal trunks, viz., from the musculo-cutaneous and anterior tibial nerves of the external popliteal, and from the external saphenous nerve of the internal popliteal. Some inconsiderable offsets to the sides of the leg from the internal and external saphenous do not require separate notice.

Musculo-cutaneous supplies certain toes; The *musculo-cutaneous nerve* has a cutaneous termination, and its place of destination is the dorsum of the foot and toes. Perforating the fascia in the lower third of the leg, it divides into two principal branches (inner and outer), which give digital nerves to the sides of all the toes, except the outer part of the little toe and the contiguous sides of the great toe and the next. The digital branches may be traced in the integument as far as the end of the last phalanx.

divides into

inner and *a.* The *inner branch* communicates with the internal saphenous nerve, and supplies the inner side of the foot and great toe: it joins also the anterior tibial nerve.

outer branch. *b.* The *outer branch* divides into three nerves, which lie over the outer three interosseous spaces, and bifurcate at the web of the foot for the supply of the contiguous sides of the four toes corresponding with those spaces: it joins the external saphenous nerve on the outer part of the foot.

Anterior tibial, where found. The *anterior tibial nerve* becomes cutaneous in the first interosseous space, and is distributed to the opposed sides of the great toe and the next. The musculo-cutaneous nerve joins it, and sometimes assists in supplying the same toes.

External saphenous. The *external saphenous nerve* comes from the back of the leg below the outer ankle, and is continued along the foot to the outside of the little toe. Occasionally it supplies both sides of the little toe, and part or more of the next.

Deep fascia of the leg; The *fascia of the front of the leg* is thickest near the knee joint, where it gives origin to muscles. It is fixed internally and externally to the tibia and fibula. Intermuscular septa are prolonged from the deep surface, and one of these, which is attached to the fibula, separates the muscles on the front from those on the outer side of the leg. Superiorly the fascia is connected to the heads of the bones, but inferiorly it is continued to the dorsum of the foot. Above and below

attachments;

the ankle joint are some strong transverse fibres, marking the position of the two parts of the anterior annular ligament; and below the end of the fibula is another band, the external annular ligament. transverse fibres at the ankle.

Dissection.— The fascia is to be removed from the leg and the dorsum of the foot, but the thickened band of the annular ligament above and below the end of the tibia is to be left. On separating the fascia from the subjacent muscles, let the edge of the scalpel be directed upwards. In like manner the fascia may be taken from the peronei muscles on the outside of the fibula, but without destroying the band below that bone. Take away the fascia.

On the dorsum of the foot the dorsal vessels with their nerve, and the short extensor of the toes are to be dissected; and, in the leg, the anterior tibial nerve and vessels are to be followed into their intermuscular space and then cleaned. Clean nerves and vessels.

The *anterior annular ligament* consists of two parts, upper and lower, which confine the muscles in their position: the former serving to bind the fleshy part to the bones of the leg, and the latter to keep down the tendons on the dorsum of the foot. Anterior annular ligament;

The *upper part* is attached laterally to the bones of the leg, and possesses a separate sheath for the tibialis anticus. its upper

The *lower part* is in front of the tarsal bones. It is inserted externally into the upper surface of the os calcis, in front of the depression for the interosseous ligament; and, internally, by a thin and widened piece into the plantar fascia and the inner malleolus. In this part of the ligament there are three sheaths: the inner one is for the tibialis anticus; the next for the extensor pollicis; and the outer one for the extensor longus digitorum and peroneus. Separate synovial membranes lubricate the sheaths. and lower part. Sheaths differ in each.

The *external annular ligament* is attached on the one side to the outer malleolus, and on the other to the outer surface of the os calcis; it contains the tendons of the peronei muscles in one sheath, which is lined by a synovial membrane. External annular ligament.

The MUSCLES ON THE FRONT OF THE LEG are three in number; they are flexors of the ankle and extensors of the toes. The large muscle next the tibia is the tibialis anticus; Muscles on the front of the leg and foot.

that next the fibula, the extensor longus digitorum; whilst a small muscle, apparently the lower part of the last, with a separate tendon to the fifth metatarsal bone, is called peroneus tertius. The one between the tibialis and extensor, in the lower half of the leg, is the extensor pollicis.

On the dorsum of the foot is only one muscle, the extensor brevis digitorum.

Tibialis anticus; The TIBIALIS ANTICUS reaches the tarsus: it is thick and fleshy in the upper, but tendinous in the lower part of the leg. origin, It *arises* from the outer tuberosity and the upper two thirds of the tibia, from the contiguous part of the interosseous ligament, and from the fascia of the leg and the intermuscular septum between it and the next muscle. After passing through the innermost compartments in the annular ligaments, insertion. the tendon is *inserted* into the under surface of the internal cuneiform bone, and sends forwards a process to the metatarsal bone of the great toe. Parts beneath the muscle, and on the sides. The muscle is subaponeurotic. It lies at first external to the tibia, resting on the interosseous membrane, but it is then placed successively over the end of the tibia, the ankle joint, and the inner line of the tarsal bones. The outer border touches the extensor muscles of the toes, and partly conceals the anterior tibial vessels as low as the foot.

Extensor pollicis The EXTENSOR PROPRIUS POLLICIS is deeply placed at its origin between the former muscle and the extensor longus digitorum, but its tendon becomes superficial on the dorsum of the foot. The muscle *arises* from the middle three fifths of the anterior narrow part of the inner surface of the fibula, attached to fibula, and from the interosseous ligament for the same distance. The tendon comes to the surface through a sheath in the lower part of the annular ligament, and then continues over the inner part of the tarsus to be *inserted* into the last and great toe: phalanx of the great toe. crosses the vessels. The anterior tibial vessels are to the inner side of the muscle as low as the sheath in the ligament, but afterwards to the outer side of the tendon, so that they are crossed by it beneath the ligament.

Extensor longus arises from fibula; The EXTENSOR LONGUS DIGITORUM, like the tibial muscle, is fleshy in the leg and tendinous on the foot. Its *origin* is from the external tuberosity of the tibia; from the head and three fourths of the inner surface of the fibula in front of the interosseous membrane; from a small part (about an

inch above) of the interosseous membrane, and from the fascia of the leg and the intermuscular septum on each side. The tendon enters its sheath in the annular ligament with the peroneus tertius, and divides into four pieces. Below the ligament these tendons are continued to the outer four toes, and are *inserted* by processes into the middle and ungual phalanges. inserted into four outer toes.

On the phalanges of the toes the tendons have the same arrangement as in the hand. For, on the metatarsal phalanx, the tendons of the long and short extensor join with prolongations from the interossei and lumbricales to form a membranous expansion. At the further end of this phalanx the expansion divides into three parts — a central and two lateral; the central piece is inserted into the base of the middle phalanx, while the lateral ones unite at the front of that bone, and are fixed into the ungual phalanx. Arrangement of the tendons on the toes.

In the leg the muscle is placed between the peroneus on the one side, and the tibialis anticus and extensor proprius pollicis on the other; it lies on the fibula, and on the lower end of the tibia and the ankle joint. On the foot the tendons rest on the extensor brevis digitorum; and the vessels and nerve of this part are internal to them. Connections of the muscle.

The *peroneus tertius* is situate below the extensor longus digitorum, from which it is seldom separate at its origin. It arises from the lower fourth of the inner surface of the fibula in front of the membrane between the bones, from the lower end of the interosseous ligament, and from the intermuscular septum between it and the peroneal muscles; and it is *inserted* by a tendon into the tarsal end of the metatarsal bone of the little toe. This muscle has the same connections in the leg as the lower part of the long extensor, and is contained in the same space in the annular ligament. Peroneus tertius is the lower part of the extensor.

The ANTERIOR TIBIAL ARTERY extends from the bifurcation of the popliteal trunk to the front of the ankle joint, where it loses the name tibial, and is called the dorsal artery of the foot. The course of the artery is at first forwards, through the aperture in the upper part of the interosseous membrane, and then along the front of that membrane and the tibia to the foot. A line from the inner side of the head of the fibula to the centre of the ankle will mark the position of the vessel. Anterior tibial artery; course and extent;

connections with parts around. In the upper part of the leg the artery lies between the tibialis anticus and the extensor longus digitorum; and in the lower two thirds between the tibial muscle and the extensor proprius pollicis, but towards the lower end of the vessel, this last muscle becomes superficial, and crosses to its inner side. The artery rests on the interosseous membrane in two thirds of its extent, and is overlapped by the fleshy bellies of the contiguous muscles, so that it is at a great depth from the surface; but it is in front of the tibia and the ankle joint in the lower third, and is comparatively superficial, for it here lies between only the tendons of the muscles.

Position of veins and nerve. Venæ comites entwine around the artery, covering it very closely with cross branches on the upper part. The anterior tibial nerve approaches the tibial vessels about the middle third of the leg, and continues with them, crossing once or twice. At the lower end of the artery the nerve is on the outer side.

Branches. *Branches.*—In the leg the anterior tibial artery furnishes mostly muscular offsets, but near the knee and ankle joints other named branches take origin, and a cutaneous branch accompanies the musculo-cutaneous nerve.

Recurrent. A *recurrent branch* leaves the trunk as soon as this appears above the interosseous membrane, and ascends in the tibialis anticus muscle to the knee joint. On the joint it anastomoses with the other articular arteries.

Malleolar inner and outer. *Malleolar arteries* (internal and external) arise near the ankle joint, and, as their name expresses, are distributed over the ends of the tibia and fibula. The internal is the least regular in size and origin; the external anastomoses with the anterior peroneal artery.

Articular. Some small *articular branches* are supplied from the lower end of the artery to the ankle joint.

Dorsal artery; extent and course; The DORSAL ARTERY of the foot is the continuation of the anterior tibial, and extends from the front of the ankle joint to the posterior part of the first interosseous space; at this interval it passes downwards between the heads of the interosseous muscle, to end in the sole as before described (p. 734.).

connections. The artery is supported by the inner row of the tarsus, viz. the astragalus and the scaphoid and cuneiform bones; and is covered by the integuments and the deep fascia, but

near its termination it is crossed by the inner tendon of the extensor brevis muscle. The tendon of the extensor pollicis is on the inner side; and that of the extensor brevis digitorum on the outer side, except for about half an inch before the artery dips into the sole of the foot, at which spot this tendon crosses as before said to the inner side of the vessel. The veins have the same position with respect to the artery as in the leg, and the nerve is external to it. Position of veins and nerve.

Branches.—Offsets are given to the bones and the ligaments of the foot: those from the outer side of the vessel have received the names tarsal and metatarsal from their distribution. A small interosseous branch is likewise furnished to the first intermetatarsal space. Branches.

The *tarsal branch* arises opposite the scaphoid bone, and runs beneath the extensor brevis digitorum to the outer side of the foot, where it divides into twigs that inosculate with the metatarsal plantar, and peroneal arteries: it supplies offsets to the extensor muscle, beneath which it lies. Tarsal.

The *metatarsal branch* takes an arched course to the outer part of the foot, near the base of the metatarsal bones and beneath the extensor muscle, and its terminal branches anastomose with the external plantar and tarsal arteries. Metatarsal,

From the convexity of this arch, which is turned forwards, three *interosseous* arteries are furnished to the three outer intermetatarsal spaces: these supply the interosseous muscles, and divide at the cleft of the toes into two dorsal collateral branches. At the fore part and the back of each space the interosseous arteries join the deep vessels in the sole of the foot by means of the anterior and posterior perforating arteries. which gives interosseous.

The *first interosseous branch* (arteria dorsalis pollicis pedis) arises from the trunk of the artery as this is about to leave the dorsum of the foot; it extends forwards in the space between the first two toes, and is distributed like the other interosseous offsets of the metatarsal branch. First interosseous.

The *anterior tibial veins* have the same extent and connections as the artery they accompany. They have their usual position along the artery, one on each side, around which they form loops by cross branches; they end in the popliteal vein. The branches they receive correspond with those of the artery; and they communicate with the internal saphenous vein. Anterior tibial veins.

Peculiarities in size.—The anterior tibial may be small, or even Varieties in

anterior tibial wanting, in which case the place of its diminished or deficient part will be supplied by the posterior tibial or the peroneal artery.

Position. — On the dorsum of the foot it is often removed farther outwards than the direction of a line from the centre of the ankle to the posterior part of the first interosseous space.

and dorsal artery. *Substitution.* — The place of the dorsal artery of the foot may be taken by a large anterior peroneal artery.

Divide extensor longus. *Dissection.* — To examine the extensor brevis digitorum on the dorsum of the foot, cut through the tendons of the extensor longus and peroneus tertius below the annular ligament, and throw them towards the toes. The attachment of the muscle to the os calcis should be defined.

Extensor brevis The EXTENSOR BREVIS DIGITORUM is a short thin muscle on the dorsum of the foot. It arises from the outer surface of the os calcis in front of the groove for the peroneus brevis muscle, and from the anterior annular ligament (the lower band); the muscle ends in four tendons, which spring from as many fleshy bellies, and are *inserted* into the four inner toes. The tendon to the great toe has a distinct attachment to the base of the metatarsal phalanx; but the rest are united to the outer side of the tendons of the long extensor, and assist to form the expansion on the metatarsal phalanx (p. 741.). The muscle lies on the tarsus, and is partly concealed by the tendons of the long extensor. Its inner tendon crosses the dorsal artery of the foot.

sends tendons to four inner toes; insertion of these.

Cut through extensor brevis. *Dissection.* — The branches of artery and nerve which are beneath the extensor brevis will be laid bare by dividing that muscle near its front, and turning it upwards. By cutting through the lower band of the annular ligament over the tendon of the extensor pollicis, and throwing outwards the external half of it, the different sheaths of the ligament, the attachment to the os calcis, and the origin of the extensor brevis digitorum from it may be observed.

Follow up the nerves. The anterior tibial and musculo-cutaneous nerves are to be followed upwards to their origin from the external popliteal; and a small branch from the same nerve is to be traced through the tibialis anticus to the knee joint.

Nerves of the front of the leg. NERVES TO THE FRONT OF THE LEG. — Between the fibula and the peroneus longus muscle the external popliteal nerve divides into the recurrent articular, musculo-cutaneous, and anterior tibial branches.

Recurrent. The *recurrent articular branch* is small, and takes the

course of the artery of the same name through the tibialis anticus muscle to the knee joint.

Musculo-cutaneous

The *musculo-cutaneous nerve* is beneath the fascia in the first part of its course, and is continued between the extensor longus digitorum and the peronei muscles to the lower third of the leg, where it pierces the fascia, and is distributed to the dorsum of the foot and the toes (p. 738.). Before the nerve becomes cutaneous, it furnishes branches to the two larger peronei muscles.

supplies peronei.

Anterior tibial is with the artery.

The *anterior tibial nerve* (interosseous) is directed inwards beneath the extensor longus digitorum, and reaches the artery of the same name about the middle of the leg. From this spot it takes the course of the vessel along the foot to the first interosseous space, in which it ends on the surface (see p. 738.). In the leg it crosses the anterior tibial artery once or more, but its position on the foot is external to the dorsal artery.

Branches to muscles.

Branches. — In the leg the nerve supplies the anterior tibial muscle and the extensor of the toes. On the dorsum of the foot it gives a considerable branch to the short extensor; this becomes enlarged, and gives offsets to the articulations of the foot.

External muscles of the leg.

Muscles on the outer part of the leg. — Only two muscles are found in this situation: they are named peronei from their attachment to the fibula, and are distinguished by terms (longus and brevis) expressive of their relative length. Intermuscular processes of fascia, which are attached to the fibula, isolate these muscles from others, viz. from the soleus and flexor pollicis behind, and from the extensor longus digitorum in front.

Peroneus longus.

The peroneus longus is the more superficial of the two muscles, and passes round the outer border of the foot into the sole to end in the cuneiform and metatarsal bones. It arises from the head of the fibula; from the outer surface of the shaft of the bone for two thirds of its length, but still farther from the posterior border: and from the fascia and the intermuscular septa. Inferiorly it ends in a tendon which is contained, with that of the peroneus brevis, in the groove at the back of the external malleolus, and the sheath of the external annular ligament. Afterwards the tendon is continued in a separate sheath, below that of the peroneus

Origin from the fibula;

brevis, along the side of the os calcis to the groove in the outer border of the cuboid bone, by which it enters the sole of the foot. Its position in the foot, and its insertion into the tarsal and the metatarsal bones, are described in page 736. In the leg the muscle is immediately beneath the fascia, and lies on the peroneus brevis. Beneath the annular ligament it is placed over the middle piece of the external lateral ligament of the ankle, with the peroneus brevis, and surrounded by a single synovial membrane common to both. The extensor longus digitorum and the soleus muscles are fixed to the fibula laterally with respect to it, one being on each side.

insertion into bones of the foot. Position in the leg.

The PERONEUS BREVIS reaches the outer side of the foot, and is connected with the metatarsal bone of the little toe. It is smaller than the preceding muscle, and inferior to it in position. The muscle arises from the outer surface of the shaft of the fibula for about the lower two thirds, extending upwards internal to the other peroneus; and from the intermuscular septa. Its tendon passes with that of the peroneus longus beneath the external annular ligament, and is placed next the fibula as it turns below this bone. Escaped from the ligament, the tendon enters a distinct fibrous sheath, which conducts it along the tarsus to its *insertion* into the base of the metatarsal bone of the little toe. In the leg the muscle projects in front of the peroneus longus. On the outer side of the os calcis it is contained in a sheath above the tendon of the former muscle; and each sheath is lined by a prolongation from the common synovial membrane behind the outer ankle.

Peroneus brevis is attached to fibula. and bone of the little toe; connections.

SECTION VII.

LIGAMENTS OF THE KNEE, ANKLE, AND FOOT.

Directions.—The student may now examine the remaining articulations of the limb, and may take first the knee joint, unless this has become dry; in that case the ankle joint and the ligaments of the foot may be dissected whilst the other is being moistened.

Examine first the knee joint.

Dissection.— For the dissection of the ligaments of each articulation, it is sufficient to detach the muscles and tendons

Dissection to see

from around it, and to remove the fibrous structure that may obscure or conceal the ligamentous bands.

In the knee joint a kind of capsule is to be defined around the articular surfaces of the bones; and there are four other ligaments, anterior and posterior, internal and external, which are thickened bands at their respective parts of the articulation. Some tendons, namely, those of the biceps, popliteus, adductor magnus, and semimembranosus, are to be followed to their insertion, and a part of each is to be left. a capsule and the external ligaments.

The Articulation of the Knee. — The knee is the largest hinge joint in the body, and is formed by the contiguous ends of the tibia and femur with the patella. The articular surfaces of the bones are covered with cartilage, and are maintained in apposition by the following ligaments: — Bones in the knee joint.

A *capsule* surrounds the ends of the bones, and fills the intervals between the stronger special ligaments. The fascia lata is closely united with it. In front it receives accessory fibres from the vasti and crureus, and from the biceps and sartorius; and, behind, from the tendon of the semimembranosus. It is connected with the interarticular cartilages, and the tendon of the popliteus muscle perforates it. Capsule only an imperfect covering.

a. The *external lateral ligament* is round and cord-like; it is attached to the outer condyle of the femur below the tendon of the gastrocnemius, and descends vertically between two pieces of the tendon of the biceps to the outer part of the head of the fibula. A second fasciculus, *short external lateral* ligament, is sometimes found behind the other. Beneath the ligament are the tendon of the popliteus, and the external lower articular vessels and nerve. External lateral ligament is small.

The *tendon* of the *biceps* is inserted into the upper part of the head of the fibula by two processes, and from one of these there is a prolongation to the head of the tibia. The external lateral ligament passes between the pieces into which the tendon splits. Tendon of the biceps is divided.

The *tendon* of the *popliteus* may be followed to the femur by dividing the external lateral and capsular ligaments. It arises from the fore part of the oblong depression on the outer surface of the external condyle of the femur: and in its course to the outside of the joint, it crosses the external Tendon of the popliteus is attached to outer condyle;

semilunar cartilage and the upper tibio-peroneal articulation. When the joint is bent, the tendon lies in the hollow on the condyle.

adductor magnus to the inner. The *tendon* of the *adductor magnus* is inserted into a tubercle on the inner surface of the internal condyle above the attachment of the internal lateral ligament.

Internal lateral ligament; attachments; *b*. The *internal lateral ligament* is scarcely distinguishable from the capsule at its attachment to the condyle of the femur; but it becomes thicker, and separate from the capsule opposite the head of the tibia, and is fixed to the inner surface and the posterior border of the tibia nearly as low as the popliteus muscle. The tendons of the sartorius, gracilis, and semitendinosus muscles lie over the ligament; and the tendon of the semimembranosus, and the internal lower articular vessels are beneath it: to the posterior edge some fibres of the tendon of the semimembranosus are added.

is joined by semimembranosus.

Insertion of the semimembranosus. The *tendon* of the *semimembranosus* muscle is to be followed beneath the internal lateral ligament. It is inserted beneath the ligament into an impression at the hinder part of the inner tuberosity of the head of the tibia, and sends some fibres to that band; it gives also one membranous prolongation to join the fascia covering the popliteus muscle, and another to the posterior ligament of the knee joint.

Posterior ligament. *c*. The *posterior ligament* (ligament of Winslow) is formed in great part by the fibres from the tendon of the semimembranosus, which are directed across the joint to the outer condyle, but a deeper set of fibres is continuous with the general capsule. Numerous apertures exist in it for the passage of vessels and nerves to the interior of the articulation.

Two sets of fibres.

Anterior ligament, or tendon of the extensors. *d*. The *anterior ligament* (ligamentum patellæ) or the tendon of insertion of the extensor muscles of the leg, is about three inches long, and is narrower in the middle than at the ends. Superiorly, it is attached to the lower part of the patella and the depression on the inner surface; and, inferiorly, it is inserted into the tubercle of the head of the tibia, and an inch of the bone below it. The expansion of the vasti covers it; and a bursa intervenes between it and the tubercle of the tibia (see p. 679.).

Open the *Dissection.*—To see the reflections of the synovial mem-

brane raise the knee on blocks, and open the joint by an incision on each side from the front to the back above the patella. When the anterior part of the capsule with the patella is thrown down, a fold (mucous ligament) will be seen extending from the end of the femur to the front of the joint below the patella. On each side of the knee-pan is a similar fold (alar ligament), containing some fat. knee joint,

The limb is afterwards to be taken from this position, and part of the posterior ligament is to be removed, to lay bare the crucial ligaments at the back of the joint; but the limb is to be replaced in the former position before the structures are learnt. and dissect crucial ligaments.

The *synovial membrane* lines the interior of the capsule, and is continued to the articular ends of the bones. Besides covering the capsule, it invests the interarticular cartilages, and sends a pouch between the tendon of the popliteus and the external cartilage and the head of the tibia: it is likewise reflected over the strong crucial ligaments at the back of the joint. On the front of the femur the sac of the membrane extends two inches above the articular surface. In the centre of the joint is a fold (mucous ligament) which contains a small vessel and some fatty tissue, and extends from the interval between the condyles to the fat below the patella. On each side of the patella is another fold (alar ligament), occasioned by the fat at this spot, which is continuous with the former below the patella. Synovial membrane extends above articular surfaces; is thrown into folds named mucous and alar ligaments.

Dissection.—The ligamentous structures within the capsule will be brought into view, whilst the limb is still in the same position, by detaching the patella and its ligament, and clearing away the fat behind it; but in this step the student must be careful of a small transverse band that connects anteriorly the interarticular cartilages. The remains of the capsule and the synovial membrane are finally to be cleared away from both the crucial ligaments and the interarticular cartilages. Dissect internal ligaments.

Ligaments within the capsule.—The remaining ligamentous structures, although within the capsule, are external to the sac of the synovial membrane which is reflected over them: they consist of the crucial ligaments in the middle line: and of two flat plates of fibro-cartilage, the interarticular or semilunar, on the head of the tibia. Other ligaments within the capsule.

Two crucial ligaments.

The *crucial ligaments* are two strong fibrous processes, which intervene between the ends of the tibia and femur, and chiefly maintain those bones in contact. They cross one another somewhat like the legs of the letter X, from which circumstance they have received their name. One is anterior to the other at the attachment to the tibia.

Anterior is oblique; its attachments;

a. The *anterior* ligament is oblique in its direction, and is smaller than the posterior. Inferiorly it is attached to the inner lip of the hollow in front of the spine of the tibia, close to the inner articular surface; and superiorly it is inserted into the back part of the outer condyle of the femur, on the inner surface, and slightly into the interval between the condyles.

posterior is vertical

b. The *posterior* ligament is almost vertical between the bones at the back of the joint. By the lower end it is fixed to the back of the depression behind the spine of the tibia, near the margin of the bone; and by the upper extremity it is inserted into the fore part of the hollow between the condyles of the femur, and into the contiguous surface of the inner condyle.

Their use in

The use of these ligaments in the movements of the joint, after the other ligaments have been cut through, should be studied.

slight flexion and extension. In extreme flexion and extension.

When the joint is only slightly bent, the posterior ligament is stretched; and when it is straightened again the anterior band is made tense. As the ligaments act in the manner above stated in keeping one articular surface on another, both will be called into play in extreme flexion and extension. For in great flexion the anterior will be stretched with the posterior, because there is an attempt to separate the articular surfaces backwards at the same time. So in great extension, the posterior comes into action after the anterior ligament, to prevent the femur being carried forwards.

In rotation.

In rotation inwards of the tibia the ligaments are crossed tightly, and the movement is arrested by the anterior fasciculus; but in rotation outwards of that bone the ligaments untwist, becoming almost parallel, so as to allow the bone to be turned back foremost.

In keeping the

As long as both ligaments are whole the femur cannot be dislodged from the tibia. If the anterior be cut the femur

can be displaced backwards; and if the posterior is divided, whilst the other remains entire, the same bone can be brought in front of the articular surface of the tibia. bones in a line.

The *interarticular* or *semilunar cartilages* are two fibro-cartilaginous plates, which partly cover the articular surface of the tibia: they are provided with two accessory bands; one is between them at the fore part; the other, oblique, ascends to the inner condyle of the femur. They are thickest at the outer margin, where they are united by fibres to the capsule; and are hollowed on the upper surface, so as to assist in giving depth to the fossæ for the reception of the condyles of the femur. Inserted into the tibia at their extremities, they are coarsely fibrous at their attachments to the bone, like the crucial ligaments, and become cartilaginous only where they lie between the articular surfaces. The synovial membrane is reflected over them. Semilunar cartilages are two.

a. The *internal* cartilage is ovoid in form, and is a segment of a larger circle than the external. In front it is attached by a pointed part to an impression close in front of the inner articular surface of the tibia, and in a line with the anterior margin of the head of the bone. At the back, where it is much wider, it is fixed to the inner lip of the hollow behind the spine of the tibia, between the attachment of the other cartilage and the posterior crucial ligament. Internal is semicircular.

b. The *external* cartilage is nearly circular in form, and is connected to the bone within the points of attachment of its fellow. Its anterior part is fixed to the bottom of the depression in front of the spine of the tibia, and close to that point of bone; and its posterior extremity is inserted into the middle of the spine, between the two osseous points. External, nearly circular in form,

From the posterior part of this disc a ligamentous fasciculus ascends to the inner condyle of the femur, to be inserted before or behind the posterior crucial ligament. This fibro-cartilage is less closely united to the capsule than the internal, for the tendon of the popliteus muscle separates it behind from that membrane. has a band of ligament.

The *transverse ligament* is a narrow band of fibres between the semilunar cartilages at the front of the joint. Sometimes it is scarcely perceptible. Transverse ligament.

Articular surface of the bones.— The lower end of the femur presents on each side a large convex condyle, and Articular end of the femur,

a slightly hollowed part between. The articular surface on the external condyle extends highest and is the widest. Each condyloid half of the bone has the following differences in its surface: altogether in front is a trochlea or pulley-like surface formed by both: at the posterior part each is rounded and convex, but the inner one most so; whilst the intervening part of each is flattened.

tibia, On the head of the tibia are two articular surfaces, but the inner one is deepest, and has the greatest extent.

and patella. The surface of the patella is divided into two parts, but unequally, by a vertical ridge, so that the outer, which corresponds with the wider face on the external condyle of the femur, is the largest in size.

Articulation of tibia and fibula. PERONEO-TIBIAL ARTICULATIONS. — The tibia and fibula are united by ligamentous bands at the ends, where they touch, and by an interosseous ligament between the shafts of the bones. The surfaces in contact are tipped with cartilage, and provided with a synovial membrane.

Dissection of the ligaments. *Dissection.* — The muscles are to be taken away from the front and the back of the interosseous ligament; and the loose tissue is to be removed from a small band in front of, and behind both the upper and lower articulations between the tibia and fibula. After the examination of the ankle joint, a strong interosseous ligament may be seen at the lower part of the leg by forcibly tearing the bones from each other.

Upper articulation, *a.* The *upper articulation,* like the lower, is almost immovable, and therefore the structures between the ends of the bones are slight and simple. Only two small bands, anterior and posterior, are present here.

by anterior The *anterior ligament* extends before the joint from the outer tuberosity of the tibia, to the head of the fibula. The

and posterior band. *posterior* ligament, thinner than the anterior, is attached to corresponding parts of the bones behind the joint, and is covered by the tendon of the popliteus muscle. A *synovial membrane* lines the articulation, and projects upwards so as to touch that of the knee joint.

Lower articulation has *b.* The *lower articulation* possesses an anterior and a posterior band, together with an inferior ligament between the lower ends of the bones.

anterior, The *anterior ligament* reaches obliquely from the lower

end of the tibia to that of the fibula; and the *posterior* has attachments behind the joint, similar to those of the band in front. The *inferior* ligament closes the space between the contiguous ends of the tibia and fibula, and consists of transverse yellowish fibres. It is distinct from the posterior ligament, and is fixed on one side to the end of the fibula above the pit, and on the other to the contiguous surface of the tibia, as well as to part of the posterior edge of the articular surface, so as to assist in deepening the hollow into which the astragalus is received. posterior, and inferior ligament.

The *interosseous ligament* is an aponeurotic partition between the muscles on the front and the back of the leg. Its fibres are for the most part directed downwards from the outer border of the tibia to the ridge on the anterior or inner surface of the fibula; but some few cross in the opposite direction. Both superiorly and inferiorly is an aperture which transmits vessels, viz. the anterior tibial at the one spot, and the anterior peroneal at the other. Some strong irregular bundles of fibres, which constitute the *inferior* interosseous ligament, extend between the bones below the aperture for the anterior peroneal artery; these take different directions, like the fibres of the rest of the interosseous membrane. Interosseous ligament between the bones, inferior ligament.

Articulation of the ankle. — Like the knee the ankle is a ginglymoid or hinge joint. In this instance the upper surface of the astragalus is received into an arch formed by the lower ends of the tibia and fibula, and the four ligaments belonging to this kind of articulation connect together the bones. Bones of the ankle joint.

Dissection.—To make the dissection required for the ligaments of the ankle joint, the fibrous tissue and vessels must be removed from the front and back of that articulation. For the purpose of defining the lateral ligaments, the limb must be placed first on one side and then on the other: the internal ligament is wide and strong, and is beneath the tendon of the tibialis posticus; the external is divided into three separate pieces, and to find these the peronei muscles, and the remains of the annular ligament below the outer malleolus should be taken away. Dissection of the ankle joint.

The *anterior* or tibio-tarsal *ligament* is a thin fibrous membrane, which is attached to the tibia close to the articular Anterior ligament is thin

and imperfect. surface, and to the upper part of the astragalus near the articulation with the scaphoid bone. The ligament is not usually a continuous membrane, for in it are some rounded intervals and apertures for vessels. On the sides it joins the lateral ligaments.

Posterior ligament. The *posterior ligament* is thinner internally than externally; and it is inserted into the tibia and the astragalus, close to the articular surfaces. Towards the outer part is a bundle of transverse fibres which is attached to the hollow on the inner surface of the external malleolus.

Internal or deltoid; attachments. The *internal lateral* or deltoid *ligament* is attached by its upper or pointed part to the inner malleolus, and by its base to the astragalus, the os calcis, and the scaphoid bone. From its upper attachment the fibres radiate to their insertion below in this manner; — the posterior are directed to the hinder part of the inner surface of the astragalus; the middle pass vertically to the side of the sustentaculum tali of the os calcis; and the anterior which are thin and oblique, join the inferior calcaneo-scaphoid ligament, and the inner side of the scaphoid bone. The tendons of the tibialis posticus and flexor longus digitorum are in contact with this ligament.

External has three parts; The *external lateral ligament* consists of three separate pieces, anterior, middle, and posterior: two of these (anterior and posterior) are attached to the astragalus, and the other anterior, to the os calcis. The *anterior* piece is a short flat band, which is directed from the fore part of the malleolus to the astragalus, in front of the lateral articular surface. The middle, *middle* portion is flattened, and descends from the tip of the malleolus to the outer surface of the os calcis, about the and posterior. middle. The *posterior* part is the strongest, and is almost horizontal in direction; it is connected externally to the pit on the inner surface of the malleolus, and is inserted into the posterior part of the astragalus behind the articular surface extending to the groove for the flexor proprius pollicis Connections. tendon. The posterior and middle fasciculi are in contact with the peronei muscles. The middle part is but slightly in contact above with the synovial membrane of the ankle joint; and both it and the under surface of the posterior piece touch the synovial membrane between the astragalus and the os calcis.

Open the *Dissection.*—Dividing the ligaments of the ankle joint,

separate the astragalus from the bones of the leg, to see the osseous surfaces entering into the joint. ankle joint.

Articular surfaces. — On the tibia there are two articular faces, one of which corresponds with the end of its shaft, and the other with the malleolus; but on the fibula only the surface of the malleolus, which is turned to the astragalus, is tipped with cartilage. The astragalus has a central articular surface, which touches the end of the tibia; and on the sides are similar articular impressions that are in contact with the malleoli, but the outer one is the largest. Surfaces of the bones in the joint.

The *synovial membrane* of the joint lines the capsule, and sends a process upwards for a short distance between the tibia and fibula. Synovial sac.

Articulations of the astragalus and os calcis. — These two chief bones of the tarsus are united to one another, as well as to the bones in front of them, by separate articulations. Articulations of the two chief bones.

Dissection. — All the rest of the joints of the foot will be demonstrated by removing from both the dorsum and the sole the parts that have been already examined, and then cleaning the ligaments. Between the different tarsal bones bands of ligament extend, which will be defined by removing the areolar tissue from the intervals between them. Dissection for the joints of the tarsus.

a. The astragalus with the os calcis. — These bones are kept together by a strong interosseous ligament; and there is also a thin band on both the outer side and behind. Astragalus with os calcis, by

The *posterior ligament* consists of a few fibres between the bones, where they are grooved by the tendon of the flexor pollicis; and the *external* ligament is connected to the sides of the astragalus and os calcis, near the middle piece of the external lateral ligament of the ankle joint. The *interosseous ligament* consists of strong vertical and oblique fibres, which are attached above and below to the depressions on the contiguous surfaces of the two bones. This band extends across the bones, and its depth is greatest at the outer side. When the astragalus is subsequently removed articular surfaces and synovial sacs will be seen between the bones. There are *articular surfaces* where the bones touch, viz. one behind the ligament, and one or two in front of it. Two *synovial membranes* exist between the bones, one for each articulation; and the one in front of the interosseous posterior, external, and interosseous ligament. Articular surfaces and synovial membranes.

ligament is continued between the head of the astragalus and the scaphoid bone.

Astragalus with scaphoid bone.

b. The astragalus with the scaphoid bone. — The large head of the astragalus is received into the hollow of the scaphoid bone, and is united to it only by a dorsal ligament; but the place of plantar and lateral ligaments is supplied by strong bands between the os calcis and the scaphoid bone, which will be presently noticed.

Dorsal ligament.

The *dorsal* or *astragalo-scaphoid ligament* is attached to the astragalus close to the articulation, and to the dorsal surface of the scaphoid bone; its attachments will be better seen when it is cut through. The *synovial membrane* of the joint is the same as that for the articulation between the astragalus and the anterior part of the os calcis.

Synovial membrane.

Os calcis and scaphoid, by

c. The os calcis with the scaphoid bone. — These bones are not in contact, but ligamentous bands extend between them both below, and on the outer side of the head of the astragalus, which serve as inferior and lateral ligaments to the astragalo-scaphoid articulation, and make more complete the socket for the reception of the fore part of the astragalus.

inferior and

The *inferior ligament* (calcaneo-scaphoid) will be defined in the sole of the foot by removing some fibro-cartilaginous substance from it; and its upper surface, together with the outer ligament, will be brought into view by sawing off the part of the astragalus that is in front of the interosseous ligament to the os calcis. It is attached by one extremity to the anterior part of the os calcis (sustentaculum tali), and by the other, to a groove on the inner and under surfaces of the scaphoid bone. The tendon of the tibialis posticus is beneath the ligament in the sole of the foot in the upright posture of the body, and on it the head of the astragalus rests. The *external calcaneo-scaphoid* is placed outside the head of the astragalus, and serves as a lateral ligament to the astragalo-scaphoid articulation; it is about three quarters of an inch deep, except at the centre where it is narrowed. Behind, it is fixed to the os calcis, between the articular surfaces for the cuboid bone and the astragalus; and in front it is attached to the outer side of the os scaphoides.

external ligaments that

As these ligaments enter into the articulation of the astragalus with the scaphoid bone, they are lined by the same synovial membrane.

enter into astragalo-scaphoid articulation.

d. The os calcis with the cuboid bone.—The ligaments in this articulation are plantar and dorsal, the former being much the strongest; and there is also an internal or interosseous band. Os calcis with cuboid bone, by

The *dorsal ligament* (superior calcaneo-cuboid) is a thin fasciculus of fibres, which is attached to the upper surfaces of the contiguous ends of the os calcis and the cuboid bone, and is divided into one or two parts. At the inner side of the os cuboides is the rather strong internal or *interosseous band* from the os calcis: this is attached behind to the upper part of the os calcis, external to the outer band to the scaphoid bone, and in front to the contiguous inner part of the os cuboides. The *inferior calcaneo-cuboid ligament* in the sole of the foot is the strongest, and is divided into a superficial and a deep part:—The superficial portion (*ligamentum longum plantæ*) is attached to the under surface of the os calcis from near the tuberosities to the tubercle in front, and its fibres pass forwards to be connected with the ridge on the under part of the cuboid bone; whilst some of its inner fibres are prolonged over the tendon of the peroneus longus muscle, assisting to form its sheath, and are attached to the bases of the third and fourth metatarsal bones. The deep piece of the ligament will be seen, on division of the superficial, to extend from the tubercle and the pit in front of it on the fore part of the under surface of the os calcis, to the portion of the cuboid bone internal to the ridge. A single *synovial membrane* belongs to the articulation. dorsal; and inferior ligament. The last is strongest, and divided into two parts. Synovial sac.

Dissection.—The interosseous ligament uniting the astragalus and the os calcis is now to be cut through to demonstrate the articular surfaces, the synovial sacs, and the attachment of the ligament. Dissection.

ARTICULATIONS OF THE SCAPHOID BONE.—The scaphoid bone articulates in front with the three cuneiform bones, and laterally with the os cuboides, by dorsal and plantar bands. Union of the scaphoid bone

a. In the *articulation* with the *cuneiform bones* there are three small *dorsal* ligaments, one to each bone, but the innermost is the strongest. The place of *plantar* bands is supplied by processes of the tendon of the tibialis posticus. A *synovial membrane* lines the articulation, and sends forwards prolongations between the cuneiform bones. to the cuneiform

and the cuboid bone

b. In the *articulation* with the *os cuboides* there is a *dorsal* oblique band of fibres; a *plantar* transverse band, which is concealed by the tendon of the tibialis posticus; and a strong *interosseous* ligament between the contiguous surfaces of the bones. When the bones touch the surfaces are tipped with cartilage, and furnished with a prolongation from the common *synovial membrane* of the tarsus.

Union of the cuneiform bones

ARTICULATIONS OF THE CUNEIFORM BONES.—These bones are united to one another by cross bands; and the external one articulates with the os cuboides after a similar manner.

one with another,

a. The three *cuneiform bones* are connected together by short transverse *dorsal* bands between the upper surfaces. Similar *plantar* ligaments are wanting, except between the two innermost. There are also *interosseous* ligaments between the contiguous surfaces of the bones.

and with the cuboid bone.

b. Where the *external cuneiform* touches the *cuboid bone* the surfaces are covered with cartilage, and are furnished with either a prolongation of the common tarsal synovial membrane, or a distinct synovial sac. A *dorsal* ligament passes transversely between the two, and a *plantar* ligament takes a similar direction. Between the bones there is also an *interosseous* ligament.

Synovial sac.

The *synovial membrane* of the articulations of the cuneiform bones is common to many of the bones of the tarsus. Placed between the scaphoid and the three cuneiform bones, it sends a prolongation forwards between the inner two cuneiforms to the joints of the second and third metatarsal bones; another outwards to the articulation of the scaphoid with the cuboid bone; and sometimes a third to that of the external cuneiform with the os cuboides.

Union of the metatarsus, by

ARTICULATION OF THE METATARSAL BONES.—The bases of the metatarsal bones, except the first, are connected together by dorsal, plantar, and interosseous ligaments; and where their contiguous parts touch they are covered with cartilage, and have part of a synovial sac.

dorsal,

The *dorsal ligaments* are small transverse bands that pass from the base of one metatarsal bone to that of the next, on

plantar,

the upper surface, in the outer four toes. The *plantar* ligaments are similar to the dorsal, between the same bones.

and interos-

The *interosseous* ligaments are short, transverse fibres be-

tween the rough lateral surfaces of the outer four bones, and may be afterwards seen by tearing these asunder. seous ligaments.

Lateral union. — The outer four bones touch one another laterally, and the second lies against the internal cuneiform. At those spots they are covered with cartilage, and provided with synovial membrane, which is derived from the sacs serving for the articulation of those metatarsal with the tarsal bones. Lateral union. Synovial sacs.

The metatarsal bone of the great toe, like that of the thumb, is not united to the others by any intervening bands : it has its own joint with the internal cuneiform bone. Articulation of great toe.

The digital ends of all the metatarsal bones are further united by the *transverse metatarsal ligament;* this has been described in page 735. Anterior ligament.

Articulations of the tarsal and metatarsal bones. — The last row of the tarsus articulates with the metatarsus in the following manner ; the three cuneiform with the inner three metatarsal, and the cuboid with the outer two metatarsal bones. The bones are tipped with cartilage where they are in contact, and have, moreover, longitudinal or oblique dorsal, plantar, and lateral ligaments. Articulation of the tarsus and metatarsus.

a. The *dorsal ligaments* are thin bands of fibres, which are either longitudinal or oblique, as they extend from the tarsal to the metatarsal bones. Each metatarsal bone has one, except that of the second toe, to which there are three : — the first has its band from the inner cuneiform bone ; the second its bands from all the cuneiform bones, one from each ; the third has a ligament from the external cuneiform ; and the fourth and fifth have a fasciculus to each from the os cuboides. Dorsal ligaments.

b. Longitudinal *plantar ligaments ;* — there is one from each cuneiform to its corresponding metatarsal bone, but between the cuboid and its metatarsal bones there are only some scattered fibres. Oblique plantar ligaments between the bones are also present in the sole of the foot : for instance, a superficial fasciculus of fibres extends from the front of the internal cuneiform to the second and third metatarsal bones ; and from the external cuneiform there is a superficial band to the metatarsal bone of the little toe. Plantar are longitudinal or oblique.

c. The *lateral ligaments* are longitudinal ; they lie deeply between the bones, and are connected with the second and Longitudinal interosseous

liga-ments. third metatarsals : they will be better seen by partly cutting the transverse bands joining the bases of the metatarsals. The bone of the second toe has two, one on each side; — the inner being strong and attached to the internal cuneiform, and the outer to the middle or the outer cuneiform bone. The bone of the third toe is also provided with two lateral bands: of these the outer is fixed into the external cuneiform, and the inner into the middle cuneiform bone.*

Line of the articulation across the foot. *Line of the articulation.* — The line of the articulation between the tarsus and metatarsus is zigzag, in consequence of the unequal lengths of the cuneiform bones. To open the articulations the knife should be carried obliquely forwards from the tuberosity of the fifth to the base of the second metatarsal bone; then about two lines further back for the union of the second metatarsal with the middle cuneiform; and finally, half an inch in front of this last articulation for the joint of the internal cuneiform with the first metatarsal bone.

Three synovial membranes. The *synovial membranes* in the articulation are three in number, as in the hand. There is one between the internal cuneiform and its metatarsal bone. A second is between the cuboid and the two outer metatarsals, and serves for the adjacent lateral articular surfaces of these bones: this is not always separate from the following. The third is placed in the articulation between the middle and the external cuneiform with their corresponding (second and third) metatarsal bones, and is an offset of the common synovial membrane belonging to the articulation of the scaphoid with the cuneiform bones (p. 758.): prolongations from it are furnished to the lateral articular parts of the second, third, and fourth (inner side) metatarsals.

Separate bones for interosseous ligaments. *Dissection.* — All the superficial ligaments having been taken away, the cuneiform bones may be forcibly separated from one another and from the os cuboides; the latter bone from the os scaphoides; and the bases of the metatarsal bones from one another — to see the interosseous ligaments

* Three of these ligamentous bands are most commonly present, viz. two to the second toe, and one to the outer side of the third toe : the ligaments inserted into the contiguous surfaces of the middle and external cuneiform bones, may be wanting.

between them: the dissector will find the bones tear sometimes sooner than the ligaments.

Articulation of the metatarsus with the phalanges. — These are ball and socket joints, in which the head of the metatarsal bone is received into the cup-shaped cavity of the phalanx. Union of metatarsus and phalanges, by

Each articulation has two *lateral* and an *inferior ligament*, as in the hand, and the joint is further strengthened above by an expansion derived from the tendon of the short extensor of the toes. A distinct *synovial membrane* exists in each. In the articulation of the great toe there are two sesamoid bones, which are connected with the inferior and lateral ligaments. two lateral and inferior ligaments. Synovial sac.

All these structures are better seen in the hand, where they are more distinct; and their anatomy is more fully described with the dissection of that part. (See page 337.) See the hand.

Articulations of the phalanges. — There are two phalangeal joints to each toe, except to the first. The same ligaments are found in these as in the metatarso-phalangeal joints, viz., two *lateral* and an *inferior*. The joint between the last two phalanges is least distinct, and oftentimes the small bones are immoveably united together by bone. These ligaments receive a more particular notice with the dissection of the hand (p. 338.). Union of the phalanges same as before described in the hand.

TABLE OF THE ARTERIES OF THE LOWER LIMB.

The Femoral Artery gives off

- External pudic
  - Superior
  - inferior.
- superficial epigastric
- superficial circumflex iliac.
- Profunda
  - External circumflex
    - Ascending
    - descending
    - transverse.
  - internal circumflex
    - Muscular
    - articular
    - ascending } final branches.
    - transverse } final branches.
  - first perforating
  - second perforating
    - nutritious.
  - third perforating
  - terminal branch.
- Muscular
- Anastomotic
  - Superficial
  - deep branch.
- Popliteal
  - Muscular
  - upper internal
  - upper external articular
  - lower internal
  - lower external articular
  - azygos articular
  - sural.
  - Anterior tibial
    - Recurrent
    - cutaneous
    - muscular
    - internal malleolar
    - external malleolar
    - articular
    - tarsal
    - metatarsal
      - three interosseous.
    - first interosseous
    - communicating to deep arch
    - digital
      - To great toe and half the next.
  - Posterior tibial
    - peroneal
      - Muscular
      - nutritious to fibula
      - anterior peroneal.
    - nutritious to tibia
    - communicating to peroneal
    - articular
    - internal plantar
    - external plantar
      - Muscular
      - plantar arch
        - Muscular
        - posterior perforating
        - digital, for three toes and a half
        - anterior perforating.

N.B. The branches of the internal iliac artery that end in the limb, will be found in the table of the arteries of the abdomen.

TABLE OF THE VEINS OF THE LOWER LIMB.

The Femoral Vein, continued from the popliteal, receives

- Popliteal
  - Posterior tibial
    - external plantar
      - muscular
      - plantar arch
        - Posterior perforating
        - digital from three toes and a half.
        - anterior perforating.
    - internal plantar
    - articular
    - communicating to saphenous
    - nutritious
    - peroneal
      - Anterior peroneal
      - muscular
      - nutritious.
  - Anterior tibial
    - communicating to deep arch
      - Digital from great toe and half the next.
    - interosseous
    - metatarsal
      - Three interosseous.
    - tarsal
    - malleolar
    - communicating to saphenous
    - muscular
    - recurrent.
  - External saphenous
    - Branch from dorsal arch of foot
    - plantar
    - veins from outer side of os calcis
    - cutaneous in the leg.
  - sural
  - articular
  - muscular
- Anastomotic
  - Superficial
  - deep branch.
- Muscular
- Profunda
  - Terminal branch
  - first perforating
  - second perforating
    - Nutritious.
  - third perforating
  - External circumflex
    - Ascending
    - transverse
    - descending.
  - Internal circumflex
    - Muscular
    - articular
- Internal saphenous
  - Branch from dorsal arch of the foot
  - plantar
  - veins about os calcis
  - communicating with posterior and anterior tibial
  - communicating with deep veins of thigh
  - cutaneous from outer and inner parts of thigh
  - external pudic
  - superficial epigastric
  - superficial circumflex iliac.

TABLE OF THE NERVES OF THE LOWER LIMB.

- **Nerves of the Lumbar Plexus in the Limb.**
  - 1. External cutaneous
    - Posterior and anterior branches.
  - 2. Obturator
    - accessory
      - To obturator trunk
      - to pectineus
      - to hip joint.
    - to obturator externus
    - to articulation
    - superficial division
      - Muscular
        - To gracilis
        - to adductor longus.
      - to plexus in the thigh
    - deep division
      - To adductor brevis and magnus
      - articular.
  - 3. Anterior crural
    - Superficial portion
      - Muscular
        - To sartorius
        - to pectineus.
      - middle cutaneous
      - internal cutaneous
        - Anterior and inner branches.
    - deep part
      - Muscular
        - To rectus
        - to vastus externus - articular.
        - to vastus internus and crureus - articular.
      - internal saphenous
        - Branch to plexus over patella
        - to leg and foot.
  - 4. Branch of genito-crural
    - To integuments.
- **Nerves of the Sacral Plexus in the Limb.**
  - 1. Small sciatic
    - Inferior gluteal
    - Inferior pudendal
    - cutaneous to gluteal region, thigh, and leg.
  - 2. Great sciatic
    - Articular to hip
    - to hamstrings.
    - external popliteal
      - Articular
      - cutaneous
      - peroneal communicating
      - recurrent articular
      - musculo-cutaneous
        - To peronei
        - cutaneous to foot and toes.
      - anterior tibial
        - Muscular
        - articular
        - cutaneous to two toes.
    - internal popliteal
      - Articular
      - muscular
      - short saphenous.
      - posterior tibial
        - Muscular to flexors
        - internal plantar
          - Cutaneous of the sole
          - muscular
          - four digital
          - communicating branch
          - articular to the toes.
        - external plantar
          - Superficial part
            - Muscular
            - two digital
            - articular
          - deep part
            - Muscular
            - articular.
  - 3. To quadratus and gemelli
    - articular.
  - Superior gluteal
    - To glutei
    - to tensor vaginæ femoris.

CHAPTER X.

DISSECTION OF THE EYE.

Situation of the eyeball. Parts around and in front of it.

The eyeball is the organ of vision. It is lodged in the orbit, and is supported in this hollow on a mass of fat; it is surrounded by muscles which impart to it its several movements. Two lids or shields protect the eyeball from external injury, and moderate the quantity of light admitted into the interior; and the anterior or exposed surface is covered by a mucous membrane (conjunctiva).

The dissection to be made on the eye of the ox.

Directions. — In the absence of specimens of the human eye, the structure must be learnt on the eye of some large animal, as the ox for example. Let the student, therefore, procure half a dozen or more eyes of the ox for the purpose of dissection. One or two small basins will be needed, and in the bottom of one of them, or of a deep plate, some melted wax or tallow should be run.

Detach the muscles.

Dissection. — To see the general form of the ball of the eye, and the outer surface of the external coat, the attachment of the different muscles should be taken away, and the loose mucous membrane should be removed from around the anterior part.

Form of the ball. Position of optic nerve. Diameter.

The *ball of the eye* is roundish in form, and consists of two parts which differ greatly in appearance, viz. an opaque or posterior, forming four fifths of the whole, and a smaller transparent portion (cornea) in front; these two parts are segments of different-sized spheres, and the anterior portion belongs to the smaller sphere. To the back of the globe the optic nerve is attached, rather to the inner side of the axis of the ball; and around it the nutritive vessels and the nerves are disposed. The antero-posterior diameter of the ball amounts to about an inch, and exceeds the transverse by about a line.

Outline of the constituents of the

The organ of vision is composed of certain parts essential to sight, and of others requisite for their protection and support. Its sentient constituent is a delicate expansion of

organ of vision. the optic nerve (retina). Within the nervous expansion are central transparent parts to bring the rays of light to a focus on it; and in front of these is a moveable curtain (iris) to regulate the perfection of the image in the interior. To defend such delicate structures, certain denser strata or coats are arranged around them; and to absorb the superabundant rays of light entering the eyeball, one of them is provided with dark pigment.

Number of coats and central parts. The coats of the eyeball, forming three strata, are arranged one within another, and are named sclerotic, choroid, and retina. The transparent media in the interior are likewise three, viz. the lens, the aqueous humour, and the vitreous body.

Dissection. *Dissection.*—To obtain a general idea of the structures to be dissected, the student may destroy one eyeball for that purpose by cutting through it circularly: he will then be able to recognise generally the arrangement of the parts mentioned above, and their strength and appearance; and will be better able to follow the directions that are afterwards given.

Fibrous coat. FIBROUS COAT OF THE EYEBALL.—The outer casing of the eye consists of an opaque hinder part called sclerotic, and of an anterior transparent part or cornea.

Sclerotic part. The SCLEROTIC COAT (cornea opaca) is the firm, whitish, and opaque part of the external stratum of the eyeball, which supports the more delicate structures within.

Dissection to see the interior. *Dissection.*—To examine the inner and outer surfaces of this coat, and of the cornea, it will be necessary to cut circularly through the sclerotic or outer coat, with a blunt-pointed scissors, a quarter of an inch from the cornea; and then to separate the cornea from the front of the eyeball, by breaking through a structure that fixes it slightly; in raising the cornea, the student may observe the aqueous fluid escape from the containing chamber. The other structures may be then removed from the interior of the sclerotic covering; and the central parts of the ball may be set aside for subsequent use.

Form and extent. Apertures behind, The *sclerotic* tunic of the eye is bell-shaped, and extends from the entrance of the optic nerve to the margin of the cornea, forming about five sixths of the ball. At its posterior part and a little to the inner side of the centre (one

tenth of an inch), the optic nerve is transmitted through an aperture in it: this opening decreases in size from without inwards, and is cribriform when the nerve is drawn out — the lattice-like condition being due to the union with its margin of the bundles of fibrous tissue between the funiculi of the nerve. Other smaller apertures for the passage of the nutritive vessels and nerves are situate around that for the optic nerve. In front is the large rounded hole into which the cornea is received: it measures about half an inch transversely, and rather less from above down. On the outer surface this coat is smooth, except where the muscles are attached; but on the inner aspect it is covered with flocculi, and with the ends of ruptured vessels and nerves, and is of a dark colour. The sclerotic covering is thickest at the back of the eyeball, but it becomes thinner and whiter towards the cornea, where it is visible as the "white of the eye;" where it joins the cornea it becomes again somewhat thickened.

and in front.

Outer and inner surface.

Thickness.

Structure. — The sclerotic coat is formed of layers of white fibrous tissue, mixed with yellow or elastic fibres, together with ramified anastomosing stellate or spindle-shaped cells with nuclei. Though interlaced with one another, the fibres have rather a longitudinal direction towards the back of the ball, and a transverse one at the outer surface near the cornea. Only a few vessels ramify in the membrane. The existence of nerves in it is doubtful.

Formed of white and yellow fibrous tissue, with stellate cells.

Vessels and nerves

Cornea. — This firm transparent membrane (cornea pellucida) fits into the front of the eyeball, of which it forms about one sixth. Its shape is circular, though, when viewed in front, particularly in the ox, it appears largest in the transverse direction in consequence of the opaque sclerotic structure reaching further on it above and below than on the sides. It is smooth and soft to the touch, is convex anteriorly, but concave posteriorly, and is of equal thickness throughout. Its anterior is of rather less extent than its posterior surface. At the circumference it is blended with the sclerotic coat by continuity of tissue.

Cornea: extent and form.

Curve.

Surface.

This clear and diaphanous structure, resembling in appearance the glass of a watch, bounds the anterior chamber of the eyeball, and gives passage to the rays of light entering the organ. When the cornea is supported by the aqueous

Situation in front of the sclerotic.

Its ac-

tion on the rays of light. humour, it deflects the rays of light transmitted to the eye, and thus influences by its greater or smaller convexity the different degrees of sight at a distance. After death it becomes flaccid from the transudation of the aqueous humour; or if it is immersed in water it is rendered opaque by infiltration of the tissue by that fluid.

Has not blood-vessels. *Structure.* — The cornea is laminar in texture. In the healthy condition *bloodvessels* do not permeate its structure, Nerves. but cease in capillary loops at its circumference. *Nerves* Composed of layers. exist in it in great abundance (Schlemm). It is constructed of a special, thick part called *cornea proper:* in front of this is a thin elastic layer with an epithelial stratum; and behind it is another fine elastic membrane covered by an epithelium. The two structures in front of the proper cornea constitute the conjunctiva: and the two behind, the membrane of Demours.

Cornea proper is formed of layers, The *cornea proper* (lamellated cornea) is made up of a series of superposed layers, about sixty in number in a section at a given spot, which join one another at numerous with intervals between. points, and cannot therefore be detached for any distance.* This structure possesses great toughness; and its transparency depends upon the parallelism of the different strata, and their distance from one another being duly maintained, for, if they are disarranged by compression or other means, Its tissue continued into that of the sclerotic. the translucency is destroyed. The laminæ of the cornea are formed of fibrous tissue, continuous with that of the sclerotic coat, and containing also similar ramified nucleated cells, but here flattened into membranous layers, and arranged one over another.

Layer behind cornea. The membrane at the back of the cornea — *membrane of Demours* — consists of a basement layer (posterior elastic lamina, Bowman) covered by epithelium.

Posterior elastic layer: The *posterior elastic layer* may be peeled off after a cut has been made across the cornea. It is a thin, but dense and hard membrane, $\frac{1}{3000}$th to $\frac{1}{2000}$th of an inch in thickness, which tears readily when an attempt is made to detach it, and curls up with the attached surface innermost when

* The facts stated in this, and in many other places in the description, are obtained from Mr. Bowman's *Lectures on the Eye*, and from the *Physiological Anatomy*, part third, 1847, of Dr. Todd and Mr. Bowman.

it is separated; it is always transparent, and remains so after boiling, after the action of acids, and even after maceration. At the edge of the cornea this lamina breaks up into processes ("pillars of the iris,") which turn backwards, and become blended with the outer margin of the iris, and with the choroid and sclerotic coats. Though very elastic, this membrane is apparently without a definite structure. A laminar *epithelium*, like that on serous membranes, clothes its free surface. characters; attachment at margin; has an epithelium.

The *conjunctiva* in front of the cornea has also a basement layer (anterior elastic lamina, Bowman), with an epithelial covering in front. Layer in front of cornea.

The *anterior elastic layer* is a transparent structure, similar in its properties to the posterior, but thicker than it (from $\frac{1}{2000}$th to $\frac{1}{1200}$th of an inch), which extends over the front of the cornea, and seems to be the basement membrane of the conjunctiva. From its posterior surface fine shreds are continued into the cornea proper. The *epithelium* is formed of three or four layers of scales, the deeper being columnar, but the superficial laminar in form. Anterior elastic layer is part of conjunctiva; has an epithelium.

Vascular Coat of the Eyeball.—The next covering is within the sclerotic, and is formed chiefly of bloodvessels and pigment cells; its strength is but slight, and its interior is lined by a pigmentary membrane. It may be divided into three parts; a posterior (choroid) corresponding with the sclerotic; an anterior (iris) opposite the cornea; and an intermediate ring (ciliary ligament and muscle) on a level with the union of the sclerotic and cornea. Choroid coat is vascular. Components.

Dissection.—Supposing only the sclerotic coat of an eye cut through near the anterior part, as before directed (p. 766.), it will be necessary, in order that the choroid coat may be laid bare, to take away the rest of the sclerotic. The outer coat is to be removed in water, and two or more incisions are to be directed backwards in it, on the sides of the ball, to the optic nerve. In removing the flaps some slight connections are to be broken through, but the slender vessels and nerves are to be preserved. The white ring around the eye in front, which comes into view during the dissection, is the ciliary muscle which limits the extent forwards of the black choroid coat. Dissection to see the choroid coat.

For the purpose of seeing the anterior termination of the To see

the ciliary processes choroid coat in the ciliary processes, let another eyeball be taken on which the sclerotic covering has been divided, and the cornea removed as before; and after making two or three cuts in the sclerotic towards the optic nerve, the resulting flaps should be pinned to the wax in the plate, so as to support the eye in an upright position. Let another eye be prepared in the same manner. On the one ball, in which the anterior view of the processes is to be obtained, proceed to remove with care the iris, tearing it away from both the white ring of the ciliary muscle and ligament, and the ciliary processes beneath, so as to leave these undisturbed and displayed. On the other ball a posterior view of the processes is to be prepared: in this dissection the iris is to be left untouched, but the choroid coat is to be divided around with a scissors, a little behind the ring of the ciliary muscle, and to be taken away with that ligament, the attached iris, and the ciliary processes behind — all in one piece. By gently washing the back of the iris the small processes will be made manifest. By means of the last dissection, the interior of the choroid coat may be seen. The structure of the membrane may be examined on a fragment obtained from the eye that was destroyed in making the preparation of the sclerotic coat.

by an anterior

and a posterior view.

To see the interior, and the structure.

To make a vertical section. If a vertical section is made of another eyeball, it will show the ciliary processes in their natural position, and will demonstrate the relative situation of all the parts. This section, which it is difficult to make, should be attempted in water with a sharp, large knife, and on a surface of wax or wood: after the eye has been divided, the halves should remain in water.

Form and extent. The CHOROID COAT is a thin membrane of a dark colour, and forms a segment of a sphere; like the sclerotic stratum, it extends from the optic nerve to the fore part of the eyeball. When viewed on the eye in which the ciliary ligament is entire, it appears to end at the ligament; but it may be seen in the other dissections to bend inwards behind that ring and the iris, and to end in a series of folds or processes (*pars plicata*), around an anterior opening for the admission of the rays of light. This covering is thicker and stronger behind than in front: it is supported at the bottom of the eyeball by its close connection to the sclerotic coat, and in

Anterior termination.

front, by the ciliary ligament. Posteriorly it is pierced by a round aperture for the passage of the optic nerve; and anteriorly is the large opening within the ring of folds called ciliary processes. The outer surface is flocculent, and is covered by the remnants of a pigmentary areolar tissue (membrana fusca) between it and the sclerotic coat; on it may be seen small veins arranged in parallel arches as they open into larger trunks, and lying on its surface are the ciliary vessels and nerves. The inner surface is smooth, and is lined by a thin pigmentary epithelial layer (membrana pigmenti), though in the eye of the ox it shines through that layer with a metallic lustre. Openings. Outer surface rough; inner smooth.

The *ciliary processes*, or the folds or plaits by which the choroidal coat terminates in front, are arranged around the lens, like the many petals of a flower, forming a circle (corpus ciliare). These processes, about 85 in number, lie side by side, and consist of larger and smaller folds, but the differently sized folds do not regularly alternate; at their inner extremities they are united by loops or transverse ridges. The folds are thin externally at the commencement, but increase in depth internally, becoming hemispherical in form, and project inwards around the lens. By their free ends they bound circumferentially the space (posterior chamber) behind the iris. Behind, the ciliary processes are closely connected with the membrane (suspensory ligament) on the front of the vitreous humour, and fit into hollows between folds on the anterior aspect of that membrane. In front they correspond with the back of the iris, but are separated from it by pigment. Ciliary processes. Position. Two kinds, small, and large. Connections with parts around.

Structure.—The choroid coat and its ciliary processes are formed principally of bloodvessels, whose branches are so arranged as to form an outer and an inner layer. Ramified pigment cells make up the rest of the coat. Parts entering into its structure.

In the outer layer the larger branches of both arteries and veins are contained, and the veins form parallel curves (*vasa vorticosa*) as they end in four or five chief efferent trunks. In the interspaces of the vessels towards the outer surface there are ramified irregular pigment cells, which contain a nucleus and molecular grains of dark brown colouring matter. The offsets of these unite together, and form the fibrous web of this tunic, but towards the inner surface, A plexus of bloodvessels with large meshes and pigment cells externally,

where the vessels form a close plexus, the pigment cells are wanting in it. In the inner layer the vessels form a network of capillaries with meshes smaller than elsewhere, whose interstices are rather less towards the back than the front of the eyeball: this part of the choroidal coat is sometimes described as a separate layer (*tunica Ruyschiana*).

but very close internally.

Structure of ciliary processes.

In the ciliary processes there is also a texture of ramified bloodvessels though with larger capillary meshes; and the intermixed pigment cells lose their colouring matter towards the tips of the folds.

Pigmentary layer formed of cells that contain the pigment.

The *pigmentary membrane* (choroidal epithelium).—On the inner surface of the choroid coat and ciliary processes is a pigmentary lining. This structure is easily detached; it consists in great part of a single stratum of six-sided nucleated cells with granular contents, which are applied to each other by their edges. It has this constitution as far forwards as the ciliary processes, but in front of that line it is several layers deep, and the cells are rounded. In the eye of the ox the colouring matter is absent from the cells in the bottom of the eye, and allows some fibrous tissue of the choroid (*tapetum*) to shine through it; and in the albino the pigment is altogether deficient in the cells, so that the vessels give a red appearance to the interior of the eye. This dark layer absorbs the superabundant rays of light entering the eyeball.

Occasionally pigment absent.

Ciliary ligament.

CILIARY LIGAMENT AND MUSCLE.—In the eye from which the sclerotic coat has been removed, the white band of the ciliary ligament (*annulus albidus*), with the muscle close behind it, may be seen in its natural position outside the part of the choroid coat that is reflected inwards to form the ciliary processes.

Situation.

Ciliary ligament.—This narrow circle (about $\frac{1}{40}$th of an inch thick) is situate in the ball of the eye nearly opposite the junction of the cornea with the sclerotic tunic, and serves the purpose of uniting the other coats at the fore part of the eye. Externally it is closely connected with the sclerotic, but a small interval the *sinus circularis iridis* exists between the two. Its fibres are circular; they are stiff, and resemble those of elastic tissue in their properties.

Connections with other parts.

Fibres.

Ciliary muscle.

The *ciliary muscle* consists of unstriated fibres, and forms a grayish layer, about $\frac{1}{10}$th of an inch wide, on the surface

of the choroid coat, close to the ciliary ligament. It is connected in front with the sclerotic coat, and the radiating fibres of the posterior elastic layer of the cornea; its fibres are directed backwards and inwards, and end on the choroid coat. The nerves to the iris pierce its fibres.

Attachments.

Iris is vascular and muscular.

The IRIS is a vascular and muscular structure, whose vessels are continuous with those of the choroidal tissue. Its position and connections may be observed in the different dissections that have been prepared.

Situation;

form.

It is suspended vertically in front of the opening in the anterior part of the choroid coat, which it partly closes, and is pierced by an aperture for the transmission of the rays of light. It is circular in form, is variously coloured in different persons, and is immersed in the aqueous humour.

Attachment.

Situation and size of the central aperture.

Anterior surface;

posterior.

By its circumference the iris is connected with the posterior elastic layer of the cornea and the ciliary ligament, and by means of the last body with the sclerotic coat close to the cornea. The aperture in it is named the *pupil* of the eye; this is slightly internal to the centre, and is nearly circular in form, but its size is constantly varying (from $\frac{1}{20}$th to $\frac{1}{3}$rd of an inch) by the contraction and relaxation of the muscular fibres, according to the degree of light acting on the optic nerve. The anterior surface is free in the aqueous humour, and is marked by lines converging towards the pupil. The posterior surface is also free, and is covered with a thick layer of pigment, to which the the name *uvea* has been applied.

Component structures.

Structure.—The stroma of the iris is composed chiefly of fibres of connective tissue, arranged in bundles, which are directed like rays towards the pupil. In it are involuntary muscular fibres, both circular and radiating, together with pigment cells. Vessels and nerves ramify through the tissue.

Muscular fibres: sphincter and dilator of pupil;

how they act;

use.

Muscular fibres.— The *sphincter of the pupil* is a narrow band about $\frac{1}{30}$th of an inch wide, which is close to the pupil on the posterior aspect. The *dilator of the pupil* is said to begin at the outer border of the iris, and its fibres, collected into bundles, join internally the sphincter. Enlargement of the pupil is supposed to be effected by shortening of the radiating fibres, and diminution, by contraction of the circular ring. The movements of the iris regulate the quantity of light admitted into the eye.

Position and form of pigment cells.

The *pigment cells* are spread out in the stroma, as well as collected on both surfaces. In the substance of the iris they are ramified and irregular cells as in the choroid; on the fore part they are ovalish or rounded, but still ramified; and behind, where there is a thick layer (uvea), the cells are rounded and filled with granules. The colour of the iris is dependent upon the colour and position of the pigment.

Pigment gives the colour.

Arteries are radiating and looped.

The *arteries* of the iris have a looped arrangement: they are derived chiefly from the long and the anterior ciliary branches, but some come from the vessels of the ciliary processes. On arriving at the ciliary muscle the former form a circle around the margin of the iris; from this loop other anastomotic branches are directed towards the pupil, near which they terminate in a second arterial circle, and end in small veins.

Nerves of the iris.

The *nerves* of the iris divide into branches, which communicate and extend towards the pupil; they are without dark outline, and their ending is not known.

Membrane of the pupil in the fetus; situation; time of disappearance.

Membrane of the pupil.—In the fetus before the seventh month the aperture of the pupil is closed by a vascular transparent membrane. This structure is attached to the anterior surface of the iris, over the situation of the inner vascular circle, and divides into two distinct chambers the space in which the iris is suspended. Vessels shoot into it from the circle before referred to, and communicate across the middle line; but at about the eighth month the vessels become impervious, and at the time of birth only fragments of the membrane remain.

Arteries of the eyeball are

Ciliary Vessels and Nerves.— The ciliary arteries are offsets of the ophthalmic (p. 49.), and supply the choroid coat, the ciliary processes, and the iris: they are classed into posterior and anterior, and two of the first set are named long ciliary, but they will not be seen without a special injection of the vessels of the eye.

posterior at the back; two of them named long ciliary.

The *posterior* (short) *ciliary* branches pierce the sclerotic coat around and close to the optic nerve, and run on the surface of the choroid membrane till they enter its substance. Two of this set (long ciliary) are directed forward to the ciliary ligament, one on each side of the eyeball, and form a circle around the iris in the ciliary muscle, as before explained, before being distributed in it; in the eye the outer

one lies rather above, and the inner rather below the level of the middle of the ball.

Anterior ciliary at the front.

The *anterior ciliary* arteries are smaller than the posterior, and arise at the front of the orbit, chiefly from muscular branches; they pierce the sclerotic coat about a line behind the cornea, and join the arterial circle of the long ciliary vessels before they end in the iris. In inflammation of the iris these vessels are enlarged, and form a ring around the cornea.

Veins form vasa vorticosa, end in the ophthalmic.

The *veins* leaving the choroid coat are commonly four in number, and the branches entering these trunks form arches (vasa vorticosa) on the surface: they perforate the sclerotic layer at separate points, midway between the cornea and the optic nerve, and end in the ophthalmic vein.

Ciliary nerves

The *ciliary nerves* are derived from the lenticular ganglion, and from the nasal nerve (p. 49.). Entering the back of the eyeball with the arteries, they are continued forwards with the vessels between the sclerotic and choroid coats nearly as far as the ciliary muscle: at this spot the nerves send offsets to the cornea and then pierce the fibres of the ciliary muscle, and enter the iris, but their manner of ending is unknown. Offsets from the nerves supply the ciliary muscle.

end in iris and ciliary muscle.

Space contains aqueous humour;

Chamber of the Aqueous Humour. — The space between the cornea in front and the lens behind, in which the iris is suspended, contains a clear fluid named the aqueous humour. In the fetus this interval is separated into two distinct parts by the iris and the pupillary membrane, but in the adult it is only partly divided, for the two communicate through the pupil. The boundaries of the two chambers may be seen in the eye on which a vertical section has been made.

is partly divided into two by the iris.

Anterior part;

The anterior chamber is the larger part of the space before mentioned; it is limited in front by the cornea, but behind by the iris and the ciliary ligament. The posterior chamber is less than half the size of the anterior. In front it is bounded by the iris; behind by the lens and a piece of the membrane (suspensory ligament of the lens) on the front of the vitreous humour; and at the circumference by the ciliary processes.

posterior; its boundaries.

Aqueous humour.

The aqueous humour is quite transparent, and consists nearly of pure water. A small quantity of chloride of

sodium, with some extractive matter, is in solution in it. It has been supposed that this fluid was secreted by a special membrane lining the cavity, but evidence of the existence of such a structure is wanting.

Retina is formed by optic nerve.

THE NERVOUS TUNIC OR RETINA. — This coat (tunica nervea) is continuous with the optic nerve, and is the most delicate of all the structures of the eyeball. On it the image of objects is produced by the rays of light being brought to a focus in the bottom of the eye.

Dissections to see the retina.

Dissection. — The retina can be satisfactorily examined only on an eye that is used before forty-eight hours have expired after death. To bring it into view on the eyeball on which the choroid coat was dissected, the choroidal covering must be torn away carefully with two pair of forceps whilst the eye is immersed in water or spirit. If an entire eye is used for the purpose, a thread may be passed through the cornea, and fastened to a pin fixed in wax; then on removing in a fluid the sclerotic and choroid coats, the retina will be laid bare. The interior of the retina may be seen in the eye from which the cornea, the iris, and the corpus ciliare have been removed in front.

Situation in eyeball;

The *retina* is the most internal of the three concentric strata in the globe of the eye, and is situate between the choroid coat and the transparent mass (vitreous humour) that is lodged in the interior. It is moulded upon, and supported by the vitreous body; and its form is that of a segment of a sphere, as in the other coats, but its aperture in front is rather larger. Beginning behind at the optic nerve, this thin layer extends forwards nearly as far as the ciliary ligament, viz. to the spot at which the choroid coat becomes folded (outer margin of the corpus ciliare), where it ends in a wavy border — the *ora serrata.* Where the retina ceases in front a thin layer of elongated nucleated cells, which are not nerve elements, is continued on to the tips of the ciliary processes.

form

and extent;

Cells prolonged in front.

Colour;

This nervous expansion is of a pinkish gray colour, and semitransparent when fresh, so that an image can be seen on it at the bottom of the eye when the two external coats are removed; but it soon loses this translucency, and is moreover rendered opaque by the action of water and other substances. Its thickness is greater at the posterior than at the anterior part of the eyeball.

transparency and thickness.

Outer surface is flocculent.

On the outer surface are some fine shreds, fragments of a structure (Jacob's membrane) to be noticed presently, which float in the fluid in which the preparation may be placed; and in a fresh eye, on which the coats have been removed from behind, a continuous layer of this membrane may be detached with care. On looking to the inside through the vitreous body, the surface will be found covered with folds, but these are accidental, in consequence of the membrane having lost its proper support; and at the spot where the optic nerve expands (porus opticus) is the central artery of the retina. In the interior of the human eye, in the axis of the ball, and $\frac{1}{10}$th of an inch outside the entrance of the optic nerve, is a slightly elliptical yellow point $\frac{1}{12}$th of an inch in diameter, which is named the *yellow spot* (limbus luteus of Sömmerring). In the centre of that spot is a minute hollow, the *fovea centralis*, which appears black in consequence of the thinnesss of the wall allowing the dark pigment outside to be seen.

On the inner surface are seen porus opticus, limbus luteus, fovea centralis.

Layers in the retina.

Structure. — In the retina are three layers or strata of different materials, together with bloodvessels: viz., an inner, composed of nerve elements; an outer (Jacob's membrane), formed of peculiar bodies; and an intermediate or granular layer. Passing vertically through the retina are other fine threads — fibres of Müller.

One of nerve substance has two strata, an inner of altered nerve tubules, and an outer of granules and nerve cells.

a. The *layer of nerve substance* is made up of the same elements as the gray matter of the encephalon, viz. of a molecular matrix containing different-sized nerve cells, with nerve fibres instead of nerve tubes; these constituents have the following arrangement: — The tubules of the optic nerve, having become solid in texture, and gray in colour from the absence of the white substance of Schwann, radiate from the end of the optic trunk, and communicate together to construct a thin stratum at the inner aspect of the nervous layer; this delicate lamina diminishes in strength as it is followed forwards. Outside the nerve fibres is a stratum of the molecular material with large pale roundish nucleated and stellate nerve cells: this begins around the entrance of the optic nerve, and becomes thinner, like the fibrous layer, as it extends forwards.

Bloodvessels in this layer.

In the nervous layer is a *plexus of bloodvessels*, which is derived from the central vessels of the retina contained in the

optic nerve (p. 49.). When the nerve becomes membraniform the artery divides into four or five branches; these pierce the stratum of fibres, and end in a network of capillaries amongst the nerve cells outside them, like the vessels in the gray substance of the encephalon, and without forming a separate layer. In animals a marginal vessel runs circularly round the ball at the anterior termination (ora serrata) of the retina. The larger branches of the artery keep clear of the axis of the eyeball, and only capillaries occupy the yellow spot. In the fetus a branch of the artery is distributed to the back of the lens.

Outer layer has special parts.

b. The *outer stratum* or columnar layer of the retina (Jacob's membrane) consists of two different elements — rods and cones, which are arranged in a single stratum, and with their ends directed inwards and outwards.

Rods.

The *rods* are elongated solid particles, which are pointed at the inner end, and are the more numerous of the two kinds of bodies. The *cones* are shaped like a flask with a long neck, and have the larger end turned inwards: they do not project so far out as the rods. When viewed on the outer surface, the cones form larger isolated swellings amongst the ends of the rods, and at a deeper level. By their inner ends both bodies are joined to the fibres of Müller.

Cones.

Characters.

In the fresh state both are clear and homogeneous, with a glistening appearance, but these characters are soon destroyed by water and other fluids.

Granular layer: two sets of granules, with material between.

c. The *granular* layer consists of innumerable rounded or ovalish bodies, collected into two sets, with an intervening fine molecular material. The intervening portion has a striated appearance, from the passage of the fibres of Müller through it.

Fibres of Müller.

The *fibres of Müller* * pass vertically through the substance of the retina from the bodies in the columnar layer, to the limiting membrane on the inner surface. They are extremely fine threads, and are supposed to be connected with the bodies in the granular layer.

Position and extent.

Membrane lining retina.

The *limiting membrane* is a very delicate layer on the inner surface of the retina, which is joined by the fibres of

* See the *Zeitschrift* of Siebold and Kölliker, 1851.

Müller, and resembles the elastic layers of the cornea in its properties.

In the *yellow spot* the nerve cells of the inner stratum form a continuous layer; whilst the nerve fibres extend only into the circumference, and the molecular material of the same layer is absent over the fovea centralis. Only the conical elements of Jacob's membrane are found in this spot. The granular layer and the fibres of Müller are absent over the central fossa. Capillary vessels occupy the spot, whilst the larger branches pass around. Constituents of retina at yellow spot.

Vitreous Body. — A transparent mass fills the greater part of the space within the coats of the eyeball, which has been named vitreous body from its resemblance to glass; it consists of a clear aqueous fluid, contained in a translucent membrane, and has the consistence of jelly. Vitreous body.

Dissection. — The vitreous body may be seen on the eye on which the retina was dissected, by taking away the retina, the ciliary ligament and processes, and the iris. To obtain a view of its anterior part with the lens in situation, an eyeball should be pinned upright on wax; the sclerotic and choroid coats should be cut through about a quarter of an inch behind the cornea (p. 766.); and on removing carefully the cornea, the ciliary ligament, and the ciliary processes, the vitreous body will become apparent. To obtain a view of it.

The *vitreous body* is globular in form, and fills four fifths of the ball of the eye, reaching forwards nearly to the iris. In front the vitreous body is slightly hollowed, and receives the lens with its capsule, to which it is closely united. The *fluid* of the vitreous body has nearly the same composition as the aqueous humour. Enveloping the whole is a thin membrane named *hyaloid*. Part of the globe filled by it. Composed of a fluid and a membrane.

The *hyaloid membrane* is the fine transparent covering of the vitreous body. It passes continuously over the surface of that mass; and in the fetus it is connected with fibres that penetrate the vitreous body. On the inner aspect are a few delicate nuclei. At the fore part it is closely united with the membrane supporting the lens, and ends by joining the back of the capsule of the lens. At the bottom of the eyeball, opposite the optic nerve, the membrane is closely connected to the parts around; and at that spot in the fetus it was reflected inwards, through the centre of the vitreous Hyaloid membrane. Connections. Process into the vitreous mass.

mass, along the bloodvessels supplying the back of the lens. This membrane and the vitreous mass are extra-vascular, and receive their nutritive material from the vessels of the ciliary processes and retina.

Suspensory ligament, extent, *Suspensory ligament of the lens* (Retzius).—This is the transparent membranous structure, situate around the lens at the front of the hyaloid membrane, which intervenes between the anterior termination (ora serrata) of the retina and the lens capsule. After the ciliary processes of the choroid coat are detached from it, dark lines of pigment cover the surface; and when these are washed away plaits or folds, *ciliary processes*, come into view, which resemble the processes of the choroid coat, but are less prominent and longer: these two sets of folds are dovetailed together, the prominences of one membrane being received into hollows on the other. In this membrane are stiff longitudinal and elastic fibres.

is marked by folds that are fitted between ciliary processes. Nature.

Canal of Petit; situation; anterior part sacculated. *Canal of Petit.*—Around the margin of the lens is a small canal, about one tenth of an inch across, which has received the above name. It is situate between the plaited part of the suspensory ligament and the front of the hyaloid membrane — being the interval of separation between the two. When the canal has been opened and distended with air, it is sacculated at regular intervals, like the large intestine, in consequence of the inflation of the plaits of the anterior boundary. The margin of the capsule of the lens projects into the space.

Lens of the eyeball. Crystalline lens and its capsule.—The crystalline lens is situate behind the pupil of the eye, and acts in bringing to a focus on the retina the rays of light passing through that aperture.

Capsule of the lens; Situation and connections. The *capsule* is a firm and very elastic transparent case, which is permeable to fluid, and closely surrounds the lens. It is seated in a hollow on the front of the vitreous body: the anterior part projecting towards the iris and the pupil; whilst the posterior is received in the vitreous body, to which it is inseparably united. The circumference of the case corresponds with the canal of Petit. Its anterior surface is free in the posterior chamber of the eye, and gives attachment towards the circumference ($\frac{1}{16}$th of an inch off) to the suspensory ligament; its posterior surface is joined by

Its anterior part is firm and transparent;

the hyaloid membrane of the vitreous body. The anterior part of the capsule is four or five times thicker than the posterior, as far outwards as to the attachment of the suspensory ligament, and supports itself after the removal of the lens; it is firm and quite transparent, being structureless, and remains clear for some time when immersed in spirit, acids, and boiling water, like the elastic layers of the cornea. The posterior part of the capsule is thin and membranous, and decreases in thickness towards the centre. posterior thin and fibrous.

In the adult human eye the capsule of the lens is not supplied with bloodvessels; but in the fetus a branch of the central artery of the retina passes through the vitreous body to supply it on the posterior aspect. Vessels to it.

Dissection.—The lens will be obtained by cutting across the thin membranous capsule in which it is enclosed. Open capsule of lens.

The lens.—When the lens is removed from its capsule, it is a solid and transparent doubly convex body; but the curves are unequal on the two surfaces, the posterior being greater than the anterior. Its margin is somewhat rounded. The density increases from the circumference to the centre; for the superficial part rubs off easily with the finger; but the deeper portion is hard and firm, and is named the *nucleus*. Its measurement from side to side is from one third to half an inch, and from before back about one fourth of an inch. On each surface are three lines diverging from the centre, and reaching towards the margin; they are the edges of planes or septa, and are so situate that those on one side are intermediate in position to those on the other. In the human eye they are not distinctly seen, because they bifurcate repeatedly as they extend outwards. Surfaces are curved unequally; density; dimensions; lines on the surfaces.

Covering the surface of the lens, and connecting it with the capsule, is a layer of very transparent nucleated cells, which can be recognised only in a fresh eye. After a little time these cells absorb moisture from the aqueous humour, and breaking down form the fluid that has been called *aqua Morgagni;* but naturally there is not any fluid between the lens and its capsule. A layer of cells joins it to the capsule.

Structure.—After the lens has been hardened by spirit or boiling, it may be demonstrated to consist of a series of layers arranged one within another, like those in an onion. Under the microscope each layer may be seen to be con- Lens is laminar.

structed of minute parallel fibres. No bloodvessels are found in its texture. It consists mostly of albumen.

Form of the laminæ; The *laminæ* of each surface have their apices in the centre, where the septa meet, and may be detached from one another at that spot, and turned outwards. The constituent

constructed of minute fibres fibres of the laminæ are about $\frac{1}{5000}$th of an inch in diameter, solid and rather flat, and most flattened at the margin of the lens. The deeper fibres are narrowed and less distinct.

that are wavy at the edge, The edges are slightly wavy, and each fibre touches six others; viz. two on each side, one above, and another below;

and attached so the septa by their ends. contiguous fibres are therefore dovetailed together, and this interlocking is best seen in the lens of the codfish. They are connected at their extremities to the partitions on the opposite surfaces of the lens in this way: those that are attached to the pole or the spot where the septa meet on the one aspect, are fixed to the extremity of a septum on the other aspect; and the rest of the fibres passing between two septa, begin and end at points that are not corresponding.

Changes in situation; *Changes with age.*—In infancy the lens is situate further forwards than in adult age, and touches the iris. Its form

form, is nearly spherical in the fetus, but its convexity decreases with age, particularly on the anterior aspect, until the lens

colour, and becomes flattened in old people. In the fetus it is reddish in colour, is soft, and is not quite transparent; in youth and

consistence. mature age it is firm and clear; and in old age it becomes denser and of a yellowish colour.

CHAPTER XI.

DISSECTION OF THE EAR.

THE organ of hearing is made up of many complex parts, which are lodged in, or are attached to the surface of the temporal bone. Definition.

The sentient structure in this organ, as in the eyeball, is an expansion of a special nerve over a membrane containing fluid. For protection this structure is enclosed in bone. It is surrounded by certain accessory bodies which collect, and convey to it the undulations of sound. Outline of the elements of the organ of hearing.

The several parts constituting the auditory apparatus may be arranged into those outside, and those within the substance of the temporal bone. Arrangement into two sets.

A. The external set (outer ear), which may be first examined, include the pinna or auricle, and the auditory canal: the former has been noticed at page 37., and the latter is described below. Outer set.

The AUDITORY CANAL (*meatus auditorius externus*) is the passage which leads from the pinna to a cavity in the temporal bone named the tympanum, and transmits inwards sounds. Auditory canal.

Dissection. — To obtain a view of this canal, a recent temporal bone is to be taken, to which the cartilaginous pinna remains attached. After the soft parts are removed, the squamous part of the bone in front of the Glasserian fissure is to be sawn off; and the fore part of the meatus, except the portion below that gives support to the thin membrana tympani, is to be cut away with a bone forceps. How to obtain a view of it.

This *canal* is about one inch and a quarter in length, and is formed partly by bone, and partly by cartilage and membrane. Length; It is directed forwards somewhat obliquely; and is sometimes bent downwards rather beyond the middle, so that the floor slopes from that spot both outwards and inwards. direction; In shape it is rather flattened from before back- size and shape.

wards; and it is narrowest at the bent part. The outer extremity is continuous with a hollow (concha) of the external ear, and the inner is closed by the membrana tympani.

Cartilaginous part

a. The *cartilaginous* is the largest part: it is about half an inch in length, and is formed by that portion of the pinna of the outer ear which is attached to the margin of the meatus; but at the upper and posterior aspect the cartilage is deficient, and the tube is closed by fibrous tissue. Two or three fissures (fissures of Santorini) are found in the piece of cartilage.

is deficient above.

Osseous part

b. The *osseous* part is about three quarters of an inch long in the adult, and is rather constricted about the middle, near which it may be bent as before said. Its outer extremity is dilated, and the posterior projects further than the anterior wall; the greater part of the margin is rough, and gives attachment to the cartilage of the pinna. The inner end is less dilated, and is marked, except at the upper part, by a groove in the dry bone for the insertion of the membrane of the tympanum; it is so sloped that the anterior wall juts beyond the posterior by about two lines.

outer end; inner end.

Condition in the fetus.

In the fetus the osseous part is absent. After birth it grows out of the osseous ring (tympanic bone) which supports the membrana tympani, and joins the rest of the temporal bone.

Lining membrane is derived from the skin.

Lining of the meatus. — A prolongation of the integument lines the auditory passage, and is continued over the membrane of the tympanum in the form of a thin pellicle. Around the entrance of the meatus are some fine hairs. In the subcutaneous tissue of the cartilaginous part of the meatus are some ceruminous glands, resembling in form and arrangement the sweat glands of the skin, which secrete the ear wax, and open on the surface by separate orifices; these are most abundant in that portion of the tube which is formed by fibrous tissue.

Ceruminous glands.

Vessels.

Vessels and nerves. — The meatus receives its *arteries* from the posterior auricular, the internal maxillary, and the temporal branches of the external carotid trunk. Its *nerves* are derived from the auriculo-temporal branch of the fifth nerve, and enter the auditory passage between the bone and the cartilage (p. 96.)

Nerves.

Internal set of the

B. The internal constituents of the auditory apparatus are

enclosed within the temporal bone, and consist of two large spaces, named tympanum and labyrinth, with their accessory parts. auditor parts.

Tympanum. The TYMPANUM, or drum of the ear, is a hollow interposed between the meatus auditorius and the deeper labyrinthic cavity. It communicates with the pharynx by a tube (Eustachian), through which the mucous membrane and the air have access to it; and it is traversed by a chain of small bones, with special muscles and ligaments connected with the ossicles. Numerous and minute vessels and nerves are in the space.

Dissection *Dissection.* — The tympanic cavity is to be opened in both a dried and a recent bone.

to open it in the dry bone, On the dry temporal bone, after removing most of the squamous portion by means of a vertical cut of the saw through the root of the zygoma, and the Glasserian fissure, the tympanum will be brought into view by cutting away with the bone forceps the anterior part of the meatus auditorius, and the projecting bone above that forms the roof of the cavity.

and in the recent bone. In the recent bone, in addition to the preparation already made of the meatus auditorius, only the roof of the tympanum should be taken away as far as may be necessary, and without doing injury to the membrana tympani, the chorda tympani nerve, and the chain of bones with its muscles.

Form and dimensions. *Form.* — The cavity of the tympanum has the form of a small, round, flat box, placed on the edge; the outer and inner boundaries being flattened and the circumference circular. Its size is greater from point to point of the circumference than across the space or from without inwards; in the former direction it is about half an inch, but in the latter not more than half that measurement.

Inner wall is marked by promontory and its grooves. The *inner boundary* is of greater extent than the outer, and on it the following objects are to be noticed. About the centre is the large projection of the *promontory*, which becomes pointed posteriorly, and is marked by two or three minute grooves that lodge the nerves forming the anastomosis of Jacobson. Above and below the posterior or narrowed part of the promontory is a large aperture, and both lead into the labyrinthic spaces. The upper opening resembles in shape the half segment of a circle, with the con-

Fenestra ovalis, vexity placed upwards, and is named *fenestra ovalis:* towards the vestibular cavity (part of the labyrinth) it has a sharp, prominent margin ; and over it, in the recent state, the inner bone (stapes) of the osseous chain is fixed. The **fenestra rotunda.** lower aperture, named *fenestra rotunda,* is rather irregular or triangular in shape, and leads into the cochlea : it is situate within a funnel-shaped hollow, somewhat oval in form on the surface. In the recent state it is closed by a thin membrane, the *secondary membrane* of the tympanum.

In outer boundary, membrana tympani and Glasserian fissure. The *outer boundary* of the cavity is formed by the membrana tympani, and by a small part of the surrounding bone. Above the membrane and in front of it, is the *Glasserian* or glenoid fissure, which is occupied, in the fresh condition of the body, by the long process of one of the small bones (malleus), and by a small muscle (laxator tympani). Crossing the membrane towards the upper part is the chorda tympani nerve, which passes through an aperture internal to or in the Glasserian fissure.

Circumference ; The *circumference* of the tympanum is circular, and in some parts it is rough and uneven on the surface. In passing around the cavity, the student may observe the following points in its anatomy.

roof ; The roof is wide and flattened, and consists of a thin osseous plate which separates the cranial and tympanic **floor.** cavities. The floor is narrow, and curved over the subjacent jugular fossa ; it presents in the dry bone more or less of an areolar or spongy texture, as well as some small apertures that open into that fossa.

At back, At the posterior part of the circumference, towards the roof, is one large and other smaller apertures leading into the **opening of mastoid cells ; pyramid ;** mastoid cells. Below this aperture, but near the inner wall and on a level with the narrowed part of the promontory, is a small conical projection, named the *pyramid:* this is perforated by an aperture, and contains the stapedius muscle. A minute canal connects the hollow in this projection with the aqueduct of Fallopius. Attaching generally the pyramid to the above-mentioned part of the promontory, is a small **aqueduct of Fallopius.** round spiculum of bone. In a line with the pyramid, and arching upwards from it above the fenestra ovalis, is a ridge of bone marking the situation of the aqueduct of Fallopius.

In front The front of the tympanic cavity corresponds with the

carotid canal, only a thin scale of bone intervening: in it are the apertures of two canals that lie on the outer side of the passage for the carotid artery:— the upper one contains the tensor tympani muscle, and the lower one is the Eustachian tube. Between the two canals is a thin osseous lamina, which is hollowed above and dilated at the inner end, and is named *processus cochleariformis*. canals for tensor tympani and Eustachian tube, with bone between.

Some parts that have been referred to above, viz. the membrana tympani, the Eustachian tube, and the secondary tympanic membrane, require a separate notice.

The *membrana tympani* is a thin partition between the meatus auditorius and the cavity of the tympanum. It is oval in form, taking the shape of the meatus, and is attached by its circumference to a groove at the inner end of the auditory passage; but in the fetus it is fitted into a separate osseous ring, the tympanic bone. The membrane is placed very obliquely with respect to the meatus, so that it meets the floor of that space at an angle of 45 degrees, and the outer surface is directed downwards. Towards the auditory canal the surface is concave; but in the tympanum it is convex, and has attached to its upper half the handle of one of the tympanic ossicles (malleus). Membrana tympani; state in the adult and the fetus. Situation; sur aces.

Structure.— This membrane is formed of three strata or structures, an external, internal, and middle. Two of these are obtained from common coverings of the body: thus, the outer one is part of the integument lining the meatus; and the inner layer is derived from the mucous membrane of the tympanum. The middle stratum is formed of fibrous and elastic tissues, and is fixed to the groove in the bone as before said: from the centre, where it is connected with the handle of the malleus, fibres radiate towards the circumference; and near the margin is a band of strong circular fibres. It is formed of a cuticular, epithelial, and fibrous stratum.

The *Eustachian tube* is the channel through which the tympanic cavity communicates with the fauces. It is about an inch and a half in length, and is directed downwards and inwards to the pharynx; like the meatus auditorius, it is partly osseous and partly cartilaginous in texture. Eustachian tube has

The *osseous* part is rather more than half an inch in length, and is narrowed at the middle. Its opening in the tympanum and its situation with respect to the canal for the tensor an osseous part; situation,

tympani muscle have been alluded to; its course in the temporal bone is along the angle of union of the squamous and petrous portions, external to the aperture that contains the carotid artery. Externally it ends in a dilated and somewhat oval opening with the longest measurement in a vertical direction, and with an irregular margin which gives attachment to the special cartilage completing the canal. The *cartilaginous* part of the tube is nearly an inch in length, and extends from the temporal bone to the interior of the pharynx. (See p. 134.) Through this tube the mucous membrane of the tympanum is continuous with that of the pharynx; and through it, by reason of its inclination downwards, the mucus passes from that cavity.

and termination.

Cartilaginous part.

Use of the tube.

Membrane in fenestra rotunda.

The *secondary membrane of the tympanum* is placed within the fenestra rotunda, and is rather concave towards the tympanum, but convex towards the cochlear passage which it closes.

Construction of three layers.

It is formed of three strata, like the membrane on the opposite side of the tympanum, viz. an external or mucous, derived from the lining of the tympanum; an internal or serous, continuous with that clothing the cochlea; and a central layer of fibrous tissue with, according to Pappenheim, some elastic tissue at the circumference.

Ossicles of the tympanum are three.

Ossicles of the Tympanum. — These are three in number, and are placed in a line across the tympanic cavity. The outer one is named malleus from its resemblance to a mallet; the next, incus, from its similitude to an anvil; and the last, stapes, from its likeness to a stirrup. For the examination of these little bones the student should be provided with some separate dry specimens, besides the ossicles that are in position in the cavity.

Malleus has head, neck, handle,

The *malleus* is the longest bone and is twisted and bent: it is large at one end (head) and small and pointed at the other (handle), and has besides two processes, with a narrowed part or neck. The *head* or capitulum is free in the cavity, is oval in shape, and is smooth except at the back, where there is a depression for articulation with the next bone. The *neck* is the slightly twisted part between the head and the processes. The *handle* or manubrium decreases in size towards the tip, and is flattened from before backwards, except at the extremity, where it is compressed from

within outwards: to its outer margin the membrana tympani is connected. The *processes* of the bone are two in number, long and short:—The *short* one springs from the root of the handle on the outer side, and is connected with the membrane of the tympanum. The *long* process—processus gracilis, is a flattened slender piece of bone, which is connected with the neck of the malleus at the anterior aspect, and extends into the Glasserian fissure: in the adult this process is joined with the surrounding bone, and cannot be separated from it. short and long process.

The *incus* is a flattened bone, and consists of a body and two processes. The *body* is hollowed at the upper and anterior part to articulate with the malleus. The two *processes* (long and short) extend from the side opposite to the articulation:—the shorter process is somewhat conical, and is received into the aperture of the mastoid cells: the long process decreases towards the extremity, where it curves and ends in a rounded and convex point, the *orbicular* process. Incus, its body; processes; short and long, with orbicular point.

The *stapes* has, like a stirrup, a base or wider part, and two sides or crura that are blended at the opposite end in a head. The *base* is formed by a thin osseous plate, which is convex at one margin and almost flat at the other, corresponding with the shape of the fenestra ovalis; the surface that is turned to the vestibule is convex, whilst the opposite is excavated. The *head* is marked by a superficial depression, which receives the orbicular process of the incus; and below it is a constricted part, the neck of the bone. The *crura* extend from the base to the neck, and are grooved, like the base, on the inner surface: the anterior crus is shorter and straighter than the other. Stapes; base; head; crura.

Position of the ossicles.—The *malleus* is placed vertically in the tympanum, with the head upwards, and the articular surface turned backwards to be connected with the incus: its handle is attached externally to the membrana tympani; and its long process is directed forwards into the Glasserian fissure. The *incus* is so placed that the long process is vertical, and the short one horizontal. Externally it is united with the malleus, and its processes are thus disposed:—the short one is received into the aperture of the mastoid cells; and the long process descends, like the handle of the malleus, Position of the malleus, of the incus,

but rather posterior to it and nearer the inner wall of the cavity, to join inferiorly with the stapes. The *stirrup* bone has a horizontal position, with the crura directed forwards and backwards: its base is fixed over the fenestra ovalis, and its head is united with the long process of the incus.

and of the stapes.

The bones have two sets of ligaments;

Ligaments of the ossicles.— The small bones of the tympanic cavity are united into one chain by articular ligaments, and are further kept in position by ligaments that fix them to the surrounding wall.

either to join one to another

a. From one bone to another. — The ossicles are connected together at the points where they touch by articulations corresponding with the joints of larger bones; for the osseous surfaces are covered with cartilage, and are surrounded by a capsular ligament of fibrous tissue, whilst a synovial sac is present in each joint. One articulation of the nature above described exists between the heads of the malleus and incus, and a second between the extremity of the long process of the incus and the head of the stapes.

in joints,

with membrane of stapes:

In the recent bone the thin mucous membrane closes the interval between the crura of the stapes, and is attached to the groove on their inner aspect.

or to fix them to the tympanic wall.

b. Between the bones and the wall.—The bones are kept in situation by the reflection of the mucous membrane, and by a special ligament from each. From the head of the *malleus* a short suspensory band of fibres is directed upwards to the roof of the tympanum. Another ligamentous band passes backwards from the *incus*, near the end of its short process, to the posterior part of the containing cavity. And the base of the *stapes* is connected to the margin of the fenestra ovalis by fibres that constitute an orbicular ligament.

Three muscles to the ossicles.

Muscles of the ossicles.—Three muscles which possess transversely striated fibres are in connection with the chain of bones; two of these are attached to the malleus, the other to the stapes.

Tensor tympani is in a bony canal, which gives it origin,

The *tensor tympani* (internal muscle of the malleus) is contained in a special bony canal, which must be laid open to see it completely: it is the largest and most distinct of the muscles of the tympanum, and takes the shape of the containing tube. The muscle *arises* from the surface of its bony canal, also slightly in front from the cartilage of the Eustachian tube. Posteriorly it ends in a tendon which, con-

tained in a sheath, is reflected over the end of the cochleariform process as over a pulley, and is *inserted* into the inner border of the handle of the malleus, near its base. It receives a special nerve from the otic ganglion. and is inserted into malleus.

The *stapedius* is lodged in the canal hollowed in the interior of the pyramid. Arising from the circumference of the tube, the muscle ends superiorly in a small tendon; this issues from the pyramid, and, incased in a sheath, is *inserted* into the neck of the stapes at the posterior part. Stapedius is in the pyramid attached to stapes.

Laxator tympani (external muscle of the malleus).—It is connected externally with the spinous process of the sphenoid bone; and its tendon, passing through the Glasserian fissure, is attached to the neck of the malleus above the processus gracilis. Laxator tympani arises outside cavity.

Mucous membrane of the tympanum.—The mucous lining of the tympanic cavity adheres closely to the wall, and is continuous with that of the pharynx through the Eustachian tube: it assists to form part of the membrana tympani, and of the fenestra rotunda, and is moreover continued into the mastoid cells through the aperture leading into them. It is reflected also over the chain of bones and the muscles and ligaments. Its surface is covered with a ciliated *epithelium.* A layer of epithelium can be detached from the inner surface of the membrana tympani, in the same manner as a cuticular stratum may be separated on the outer side. Lining of tympanum Epithelium

Bloodvessels. — The *arteries* of the tympanum are furnished from the following branches of the external carotid, viz., internal maxillary, posterior auricular, ascending pharyngeal; and some offsets come also from the internal carotid, whilst it is contained in the temporal bone. The *veins* join the middle meningeal and pharyngeal trunks. Arteries are branches of carotid. Veins.

a. The internal maxillary artery supplies a *tympanic branch* (inferior), which is distributed to the membrane of the tympanum; it gives also an offset to the cavity from the petrosal branch of the middle meningeal artery; this enters the temporal bone by the hiatus Fallopii. From internal maxillary.

b. The stylo-mastoid branch of the posterior auricular artery, entering the lower end of the aqueduct of Fallopius, gives twigs to the back of the cavity, and the mastoid cells. One of this set, *superior tympanic,* anastomoses with the tympanic branch of the internal maxillary artery, and forms Posterior auricular.

a circle around the membrana tympani, from which branches are directed inwards.

Inferior palatine. *c.* Other branches from the ascending pharyngeal, or from the inferior palatine artery, enter the space along the Eustachian tube.

Nerves from several sources. NERVES.—The lining membrane of the tympanum is supplied from the plexiform communication (tympanic plexus) established between Jacobson's and the sympathetic nerve; but the muscles derive their nerves from another source. Crossing the cavity is the chorda tympani branch of the facial nerve.

Dissection to prepare the nerves *Dissection.*—The preparation of the tympanic plexus will require a separate fresh temporal bone, which has been softened in diluted hydrochloric acid, and in which the nerves are hardened in spirit. The origin of Jacobson's nerve from the glosso-pharyngeal is first to be sought close to the skull (p. 113.); and the auricular branch of the pneumo-gastric is to be looked for at the same time. before entering,

and in the tympanic cavity. Supposing the nerves to be found, the student should place the scalpel on the outer side of the Eustachian tube, and carry it backwards through the vaginal and styloid processes of the temporal bone, so as to take away the outer part of the tympanum, but not to open the lower end of the aqueduct of Fallopius, lest the facial nerve should be injured. After the tympanum has been laid open, Jacobson's nerve is to be followed in its canal, and the branches that lie in the grooves on the surface of the promontory are to be pursued — one of these arching forwards and two coursing upwards.

The connections of the chorda tympani nerve can be seen on the preparation used for the muscles.

Tympanic nerve The *tympanic branch* of the glosso-pharyngeal nerve (nerve of Jacobson, p. 115.) enters a special aperture in the temporal bone, and is conducted by it to the inner wall of the tympanum. At this spot the nerve supplies filaments to the lining membrane of the cavity; and it terminates in the three following branches, which are contained in grooves on the promontory, and connect this nerve with others.* supplies membrane and other branches;

* Instead of viewing these filaments as offsets of the nerve of Jacobson, it may be supposed that they are branches derived from the other

Branches. — One branch is arched forwards and downwards, and enters the carotid canal to communicate with the sympathetic on the artery (p. 122.). A second is directed upwards to join the large superficial petrosal nerve in the hiatus Fallopii (p. 150.). And the third filament has the following course to reach the otic ganglion: it ascends towards the upper surface of the petrous part of the temporal bone, passing in front of the fenestra ovalis but beneath the canal for the tensor tympani muscle, and near the gangliform enlargement on the facial nerve, to which it is connected by filaments (p. 153.). Beyond the union with the facial, this nerve is named *small superficial petrosal*, and is continued forwards external to the hiatus Fallopii, but without appearing on the surface of the temporal bone, until it issues from the skull to end in the otic ganglion (p. 154.). one to the sympathetic, another to petrosal nerve, and a third to otic ganglion, called small petrosal.

Nerves to muscles.—The tensor tympani muscle is supplied by a branch from the otic ganglion (p. 155.); the stapedius receives an offset from the facial trunk; and the laxator tympani from the chorda tympani nerve (?). Nerves for the muscles.

The *chorda tympani* is a branch of the facial nerve, and is now seen in the part of its course through the tympanum. Entering the cavity behind, it crosses the membrana tympani, and issues from the space by a special aperture internal to or in the Glasserian fissure, to join the gustatory nerve. Its farther course is described at page 98. Chorda tympani crosses cavity.

The *auricular branch* of the vagus nerve, though not a nerve of the tympanum, is an offset to the outer ear, and may be now traced in the softened bone. Arising in the jugular fossa (p. 117.), the nerve enters a canal which conducts it across the lower end of the aqueduct of Fallopius, and through the substance of the temporal bone to the back of the pinna of the ear. Branch of vagus to the outer ear.

The labyrinth.—The inner and fundamental portion of the organ of hearing is so named from its complexness. It consists of dense osseous parts; and of membranous sacs for the expansion of the auditory nerve, which are contained within the former. It is divided into an osseous and a membranous labyrinth. Labyrinth formed of osseous and membranous parts.

nerves to which they are united. According to this view the *tympani plexus* would be derived from many sources.

Constituents of the osseous part. A. The osseous labyrinth consists of three parts, viz. the vestibule, the semicircular canals, and the cochlea; these communicate externally with the tympanum, and internally with the meatus internus that transmits the auditory nerve.

Vestibule. The VESTIBULE is the common central cavity of the osseous labyrinth, and is placed behind the cochlea but in front of the semicircular canals.

Dissection to see it. *Dissection.*—This cavity may be seen on the dry bone that has been used for the preparation of the tympanum. The bone is to be sawn through vertically close to the inner wall of the tympanum, so as to lay bare this wall and the fenestra ovalis leading into the vestibule: in this section one of the semicircular canals (horizontal) may be laid open just above the fenestra ovalis. By enlarging the fenestra ovalis a very little in a direction upwards and forwards, the end of the superior semicircular canal and the vestibular space will appear. Other views of the cavity may be obtained by sections of other bones in different directions, according to the skill and the knowledge of the dissector.

Form; The *vestibular space* is somewhat oval in form, the extremities of the oval being placed forwards and backwards, and the under part or floor is more narrowed than the upper part **dimensions.** or roof. It measures about $\frac{1}{5}$th of an inch in different directions, but it is narrowest from without inwards. The following objects are to be noted on the boundaries of the space.

Apertures before and behind. In front, close to the outer wall, is a large aperture leading into the cochlea; and behind are five round openings of the the three semicircular canals.

Outer wall has an aperture. The outer wall corresponds with the tympanic cavity, and in it is the aperture of the fenestra ovalis.

Crest on inner wall; On the inner wall, nearer the front than the back of the cavity, is a vertical ridge or *crista.* In front of the ridge is **fossa in front of it;** a small circular depression, *fovea hemispherica,* which presents anteriorly some minute apertures for nerves, and corresponds with the bottom of the meatus auditorius internus. **and an aqueduct behind.** Behind the crest of bone, near the common opening of two of the semicircular canals, is the opening of the aqueduct of the vestibule, which ends on the posterior surface of the petrous portion of the temporal bone.

Roof has a fossa. On the roof is a slight transversely oval depression, *fovea semi-elliptica,* which is separated internally from the fovea

hemispherica by a continuation of the crista before mentioned on the inner wall.

The SEMICIRCULAR CANALS are three osseous tubes, which are situate behind the vestibule, and are named from their form. Three canals;

Dissection. — These small canals will be easily brought into view by the removal of the surrounding bone by means of a file or some cutting instrument. Two may be seen opening near the aperture made in the vestibule, and may be followed thence; but the third is altogether towards the posterior aspect of the petrous portion of the temporal bone. preparation of them.

The *canals* are of unequal lengths, but each forms more than half a circle: they communicate at each end with the vestibule, and the contiguous ends of two are blended together so as to give but five openings into that cavity. Each is marked by one dilated extremity which is called the *ampulla*. When a tube is cut across it is not circular, but is compressed laterally, and measures about $\frac{1}{20}$th of an inch, though in the ampulla the size is as large again. Length; termination by five openings; one end dilated; form and size.

From a difference in the direction taken by the tubes, they have been named superior and posterior vertical, and horizontal. The *superior* vertical canal crosses the upper border of the petrous part of the temporal bone, where it forms a projection. Its extremities are more distant than in the other tubes: its outer end is marked by the ampulla, whilst the inner is joined with the following. The *posterior* vertical tube is directed backwards from its junction with the preceding towards the posterior surface of the temporal bone; the upper end is united with the superior vertical canal in a common tube, and the lower end is free and dilated. The *horizontal* canal has separate apertures, and is the shortest of the three. Deeper in position than the superior vertical, it lies in the substance of the bone nearly on a level with the fenestra ovalis; its dilated end is at the outer side close above that aperture. They are named superior vertical, posterior vertical, and horizontal.

COCHLEA. — This part of the osseous labyrinth has a position anterior to the vestibule, and has received its name from its resemblance to a snail's shell. Cochlea.

Dissection. — To obtain a view of the cochlea in the dried bone, it will be needful to cut or file away gradually on the preparation before used for displaying the vestibule, the sur- Dissection for it in dry

face of bone forming the promontory of the tympanum; or this may be done on another piece of bone in which the semicircular canals are not laid bare. The horizontal direction of this body will be best seen by cutting away the bone above it. To dissect the same parts in the recent state, a softened bone should be used.

and recent bone.

Form and situation;

The *cochlea* is conical in form, and is placed almost horizontally in front of the vestibular space. The base of this body is turned to the meatus auditorius internus, and is perforated by small apertures; whilst the apex is directed to the upper and anterior part of the inner wall of the tympanum, opposite the canal for the tensor tympani muscle. Its length is about a quarter of an inch, and its width at the base is about the same. Resembling a snail-shell in construction, the cochlea consists of a tube wound spirally round a central part or axis; but it differs from a shell in the fact of the tube being subdivided into two by a partition, and in the circumstance of the central part or axis being much thicker.

size.

Resembles a snail-shell in some respects.

Parts of the cochlea.

In the description of the cochlea it will be necessary to notice separately the axis or centre, the spiral tube, and the partition with the two passages.

A spiral tube closed at one end forms 2½ turns;

measurement;

The *spiral tube* forms two turns and a half around the axis, and terminates above in a closed extremity, named the *cupola.* When measured along the outer side, the tube is about one inch and a half long; its diameter at the beginning is about one tenth of an inch, but it gradually diminishes to half that size towards the opposite end. Of the turns that the tube makes, the first is much the largest; this projects at its commencement into the tympanum, and gives rise to the eminence of the promontory on the inner wall of that cavity. The second turn is included within the first. The last half turn bends sharply round, and presents a free semilunar margin (the edge of the axis) at one side. In the recent bone the tube is divided into two passages (scalæ) by a septum: in the dry bone a remnant of this partition is seen in the form of a thin plate of bone (lamina spiralis); and on the outer wall, opposite this ridge of bone, is a slight groove.

is divided into two.

A central pillar or axis

The *axis* or *modiolus* (columella) consists of the bony substance included within the coils of the spiral tube: it is

limited externally by a condensed stratum — the wall of the spiral tube; and is formed internally of a porous material. Its shape is conical, and its size diminishes rapidly towards the last half turn of the spiral tube, where it is very thin but not porous, and may be said to end, though it is commonly described as being continued upwards from this spot to the tip of the cochlea. The upper extremity, corresponding with the last half turn, is bent, and enlarged after the manner of a funnel with the base uppermost, and presents a free margin.* The axis is perforated by canals as far as the last half turn, which transmit vessels and nerves in the fresh state; and the central one is larger than the others. Winding around the axis is the thin osseous plate before referred to, the *lamina spiralis*, which projects a certain distance into the spiral tube, and forms part of the septum.

is porous and conical; how it ends above: ? in the infundibulum.

Around it is a spiral piece of bone.

Septum of the spiral tube. — The partition dividing the tube of the cochlea into two passages, in the recent bone, consists of an osseous and a membranous portion.

Septum of the tube bony and membranous

a. The *osseous* part, which is formed by the lamina spiralis, extends about half way across the tube. It begins inferiorly in the vestibule, where it is wide, and is attached to the outer wall so as to shut out the fenestra rotunda from that cavity; and diminishing in size in its progress, it ends in a free point, named the *hamulus*, opposite the margin of the modiolus at the last half turn of the cochlea. Between the point in which the osseous lamina terminates and the margin referred to, is a space which, in the recent state, is converted by membrane into a foramen (hiatus, helicotrema), and allows the intercommunication of the passages of the cochlear tube. The lamina spiralis is formed by two plates of bone, that enclose osseous canals for vessels and nerves, and are separated furthest at the modiolus.

Osseous part; that ends above in a point over an aperture, through which the scalæ join;

The side turned to the lower of the two cochlear passages is freely pierced by apertures for nerves and vessels; whilst the opposite is covered in the outer fifth of its extent by a structure resembling cartilage, which ends in a toothed edge

difference on two sides; on upper aspect is

* Some Anatomists apply the term *infundibulum* to the appearance which this bent part of the modiolus (? top of the cochlear tube) presents when it is looked at from the second turn of the cochlea. Others understand by the term the funnel-shaped space enclosed in the terminal half bend of the tube of the cochlea.

the denticulate structure. near the margin of the spiral lamina, and has been named *denticulate lamina.* (Todd and Bowman.)*

Membranous part; extent upwards; piece glassy. *b.* The *membranous* part reaches from the edge of the lamina spiralis to the groove in the outer wall of the tube of the cochlea, and is continued upwards to the top of that tube beyond the terminal hook of the lamina spiralis. Near the bony part of the partition this structure has a glassy appearance, like the elastic layer of the cornea; but beyond that spot it is a gelatinous-looking tissue, to which the authors above quoted have given the name *cochlearis muscle.*†

Two scalæ of the cochlear tube *Scalæ of the cochlea.* — These are the two passages into which the spiral tube of the cochlea is divided by its septum. They are placed the one above the other, and are named *scala vestibuli* and *scala tympani;* the former is nearest the apex of the cochlea. that join above, and end separately; Above they communicate through the aperture named helicotrema. Below they end differently, as the names express: one (scala vestibuli) opens into the front of the vestibule; the other (scala tympani) is shut out from the vestibular cavity, and is closed below by the membrane of the fenestra rotunda. differ in extent, and size at spots. On the whole they are nearly equal in size, but each has certain peculiarities: thus the vestibular scala is largest above and extends to the apex of the cochlea; whilst the tympanic scala is largest near the base. Connected with the last is the small *aqueduct* of the cochlea, which is situate close to a ridge or crest near the beginning of the scala, and opens on the under aspect of the petrous portion of the temporal bone.

Fibro-serous membrane lines the labyrinth; *Lining membrane of the osseous labyrinth.*—A thin fibrous membrane lines the vestibule, the semicircular canals, and the scalæ of the cochlea, and is likewise continued into the aqueducts of the vestibule and cochlea.‡ On the outer wall

* In the work before referred to, *Physiological Anatomy,* &c.

† The muscular nature of this structure is denied by Professor Kölliker. He considers it ligamentous.

For an account of the researches of M. Corti on the membranous part of the cochlea, the student may refer to the notice of them given in Quain's Anatomy, vol. iii. p. 64.

‡ This membrane was considered by Breschet to be originally part of the fibro-serous lining of the skull. It is supposed by him that the membrane has been gradually enclosed by bone, until the connection between it and the parent structure has been obliterated, except by

of the vestibule it assists in closing the fenestra rotunda opening into the tympanic cavity. The outer surface of the membrane is adherent to the bone; but the inner is covered by a single layer of epithelium, like that on serous membranes, and secretes a thin serous fluid, *liquor Cotunnii*, or perilymph. This fluid in the interior fills the scalæ of the cochlea, and surrounds the membranous labyrinth. has an epithelium and contains a fluid that fills cochlea.

B. The MEMBRANOUS LABYRINTH is constituted of sacs containing fluid, over which the auditory nerve is expanded. The sacs are two in number, viz. the utricle and the saccule, and have the general form of the surrounding bony parts; they are confined to the vestibule and the semicircular canals, and are surrounded by the perilymph. Two sacs float in fluid of labyrinth.

Dissection. — The delicate internal parts of the ear, with their vessels and nerves, cannot be dissected except on a temporal bone, which has been put in spirit, and afterwards softened in acid. The previous instructions for the dissection of the osseous labyrinth will guide the student to the situation of the membranous structures within it, but the surrounding softened material must be removed with great care. A lens and a microscope will be needed for the complete examination of the sacs. For the display of the blood-vessels a minute injection will be necessary. Dissection of them in a fresh bone.

The *utricle*, or the common sinus, is the larger of the two sacs, and is situate at the posterior and upper part of the vestibule, opposite the fovea semi-elliptica in the roof. It is transversely oval in form, and connected with it posteriorly are three looped tubes, which are prolonged into the semicircular canals. The sac and its offsets are filled with a clear fluid, like water, which is named endolymph; and in the wall of the sac is a small calcareous deposit (otolith) opposite the entrance of the nerve into it. The utricle; situation and form; contains a fluid and otolith.

The prolongations into the semicircular canals are smaller than the osseous tubes, being only one third of their diameter; and the interval between the bone and the membrane is filled by the perilymph. In form they resemble the bony cases, for they are marked at one end by a dilatation corresponding with the ampulla of the osseous tubes, and, further, Tubes are sent into the arched canals; they are dilated

means of the small process that lines the aqueduct of the vestibule. — *Recherches Anatomiques et Physiologiques.*

at one end, and two are blended at one end, like the canals they occupy: they communicate with the utricle by five openings, and are filled with the endolymphic fluid of that sac. At each ampullary enlargement there is in the interior a transverse projection into the cavity, and at that spot a branch of the auditory nerve enters the wall.

contain a fluid.

Smaller sac is before the other, The *saccule* is a smaller and a rounder cyst than the utricle, and is placed in front of it in the hollow of the fovea hemispherica. Like the larger sac, it has a translucent wall, in which is an otolith opposite the entrance of the nerve; it is also filled by endolymph. It is doubtful whether the two sacs communicate.

Do the two join?

Wall of the sac has three strata. *Structure of the sacs.* — The wall of the membranous labyrinth is translucent and firm; but it is more opaque where the vessels and nerves enter it. Three strata enter into the construction of the membrane, together with bloodvessels and nerves. The outer covering is loose and flocculent, and easily detached, and contains irregular pigment cells with ramifying bloodvessels. The middle stratum is clear and tough, and appears like cartilage, or, where it is thin, like the hyaloid membrane of the eyeball (Todd and Bowman). And the inner one is formed by a layer of polygonal nucleated cells, which are easily separated from one another.

Otoliths are grains of lime. The small calcareous masses, or the otoliths, consist of minute rounded and elongated grains of carbonate of lime which are situate in the inner part of the wall of the utricle and saccule. Within the enlargement of each semicircular tube a calcareous material (otolith) is contained in the cells lining it. — (Todd and Bowman.)

Blood-vessels of the membrane. Bloodvessels. — The membranes of the labyrinthic cavity receive their blood from an artery that enters the internal auditory meatus with the nerve. The veins are united into one, and end in the superior petrosal sinus.

Internal auditory artery The *internal auditory* artery arises from the basilar trunk within the skull (p. 190.), and enters the internal meatus with the auditory nerve. In the bottom of that hollow it divides into two branches — one for the vestibule, the other for the cochlea.

has a branch to membranous sacs; *a.* The *branch* to the *vestibule*, after piercing the wall of the cavity, subdivides into small branches, which ramify over

the exterior of the membranous labyrinth, and the tubes occupying the semicircular canals. The vessels end in a network of capillaries on the exterior as well as in the substance of the special layer, and this is most developed about the termination of the nerves. termination;

b. The *branch* to the *cochlea* subdivides into twigs that enter the canals in the modiolus. Small offsets from these are directed outwards through holes in the lamina spiralis, and communicate together in loops near the margin of that osseous zone, but in greatest number on that surface towards the tympanic scala. From this anastomosis vessels are supplied to the membrane lining the scalæ, and to the structure called cochlearis muscle. A capillary vessel (? venous) is placed longitudinally in the membranous part of the septum scalarum, and communicates here and there with the arterial loops before mentioned. and another to the cochlea. Mode of termination.

The *vein.* — One branch of vein is derived from the cochlea, and another from the membranous labyrinth: the two are united near the cochlea, and the trunk ends in the superior petrosal sinus in the base of the skull. Vein to petrosal sinus.

Nerve of the Labyrinth. — Only one special nerve, *auditory*, is distributed to the labyrinth (p. 198.). Entering the internal auditory meatus, the nerve divides into two branches, like the artery, viz., an anterior for the cochlea, and a posterior for the membranous labyrinth. In the trunk and in both branches there are nerve cells contained: in the nerve to the labyrinth they form a reddish swelling, which was named *intumescentia ganglioformis* by Scarpa. Auditory nerve divides into two.

a. The *cochlear branch* divides at the base of the modiolus into twigs that enter the apertures in that body. These small divisions of the nerve are directed outwards with the vessels in the canals in the lamina spiralis, but nearest the tympanic scala, where they form a plexiform arrangement, with lengthened interspaces and ganglion cells. At the edge of the bone the nerve tubules cease to divide, and reach a short distance into the membranous part of the septum scalarum, where they are arranged in conical sets parallel with one another; but their mode of ending is not satisfactorily made out. The nerve fibres do not lose the white substance of Schwann at their termination, but retain it in the minutest tubules (Bowman). A cochlear branch, whose filaments end in the septum, retaining white substance.

Professor Kölliker states that the nerves end on the vestibular surface of the membranous part of the septum, in the form of unipolar ganglion cells, and that before they terminate they lose their dark outline.

Vestibular branch divides into three;

b. The *vestibular branch* ends in three nerves for the membranous labyrinth: these pierce the cribriform plate in the bottom of the meatus, and are thus distributed: — one appertains to the utricle, and to the enlargements on the tubes contained in the superior vertical and horizontal semicircular canals; a second ends in the saccule; and the third belongs to the ampullary swelling on the tube of the posterior vertical semicircular canal.

their termination.

Termination of the vestibular nerves. — The ending of the nerve fibres on the sacs and on the ampullary enlargements is different.

On the sacs they lose white substance, and end in fibres inside.

On the *membranous sacs* the nerve divides, and its filaments separate; some filaments passing through the otolith and others outside it. Those which pass outside the calcareous matter, spread out on the inner surface; and meeting with the lining of nucleated cells, the tubules lose the white substance of Schwann, and probably end in a "fibrous film," like that of the inner stratum of the nervous layer of the retina (Todd and Bowman). The same authors state that the tubules surrounded by the otolith appear to terminate in free points, without losing their white substance.

In the arched tubes they form a projection, and end in loops therein.

In the *ampullary enlargement* of the tubes of the semicircular canals the nerve enters the concave side, where it forms a forked eminence (Steifensand), corresponding with the projection in the interior. The nerve tubules do not spread out as in the sacs, but are confined to the swelling, in which they end in a series of loops (Wagner). Some of the nerve fibres are said to terminate in free extremities as well as in loops.

INDEX.

The letter (o) prefixed to the figures refers to the origin, (c) to the course, and (d) to the distribution of a nerve or vessel that is described in different pages.

THE END.

London:
Printed by Spottiswoode & Co.,
New-street-Square.

WORKS

ON

ANATOMY, PHYSIOLOGY, SURGERY, CHEMISTRY, PHYSICS, ETC.

PRINTED FOR

WALTON AND MABERLY,

28. UPPER GOWER STREET, AND 27. IVY LANE, PATERNOSTER ROW.

Dr. Quain's Anatomy. A New and Cheaper Edition. Edited by Dr. SHARPEY and Mr. ELLIS, Professors of Anatomy and Physiology in University College, London. Illustrated by upwards of 400 Engravings on Wood. 3 vols, small 8vo. 1*l.* 11*s.* 6*d.* cloth.

Ellis's Demonstrations of Anatomy. A Guide to the Knowledge of the Human Body by Dissection. Fourth Edition. Small 8vo. 12*s.* 6*d.* cloth.

Kirkes' and Paget's Handbook of Physiology. Illustrations on Steel and Wood. Third Edition. Small 8vo. 12*s.* 6*d.* cloth.

Dr. Lardner. Animal Physics; or, the Body and its Functions familiarly Explained. Illustrated by upwards of 500 Engravings. 1 vol., small 8vo.

Erichsen's Science and Art of Surgery. 260 Illustrations. 8vo. 1*l.* 5*s.*

Dr. Gregory's Handbook of Inorganic Chemistry. Third Edition. 1 vol., 5*s.* 6*d.*, small 8vo., cloth.

Dr. Gregory's Handbook of Organic Chemistry. Fourth Edition, greatly Enlarged and Improved. 1 vol., small 8vo. 12*s.* cloth.

Dr. Jenner. A Practical Treatise on Continued
Fevers. By WILLIAM JENNER, M.D., Physician to University College Hospital, and Assistant Physician to the London Fever Hospital. 1 vol., small 8vo.

Dr. Garrod on Gout, Rheumatism, Rheumatic
Gout, and their Complications. 1 vol., small 8vo.

Dr. Walshe on Diseases of the Heart and Lungs.
Second Edition. 1 vol., small 8vo., 12*s.* 6*d.* cloth.

Dr. Walshe on Cancer.
8vo. 6*s.* 6*d.*

Dr. Murphy's Lectures on Midwifery.
8vo. Many Illustrations. 16*s.* cloth.

Dr. Murphy on Chloroform: its Properties and
Safety in Childbirth. 1*s.* 6*d.* cloth.

Dr. Hassall's Microscopic Anatomy of the Human
Body in Health and Disease. Numerous Drawings in Colour. 2 vols., 8vo. 2*l.* 5*s.*

Quain and Wilson's Anatomical Plates.
201 Lithographic Plates with Descriptions. A remarkably Cheap Issue as under.

THE COMPLETE WORK, in Two Volumes Royal Folio, Half-bound Morocco	£5	5	0
THE SAME, Full Coloured, Half-bound Morocco ...	8	8	0

The Work in separate portions, in Cloth, as follows :—

		PLAIN.			COLOURED.		
Muscles	51 Plates ..	£1	5	0 ..	£2	4	0
Vessels	50 Plates ..	1	5	0 ..	2	0	0
Nerves	38 Plates ..	1	1	0 ..	1	14	0
Viscera	32 Plates ..	0	17	0 ..	1	10	0
Bones and Ligaments,	30 Plates ..	0	17	0 ..	1	0	0

Mr. Quain on Diseases of the Rectum.
With Illustrations. Second Edition. 1 vol., small 8vo., 7*s.* 6*d.*

Sedgwick on the Nature of Cholera as a Guide to
Treatment. Small 8vo., 6*s.*

Morton's Surgical Anatomy of the Principal Regions. 25 Lithographic Plates, coloured, and 25 Woodcuts. Royal 8vo., 1*l*. 1*s*. cloth.

Dr. Ballard on Artificial Digestion as a Remedy in Dyspepsia, Apepsia, and their Results. Fcap. 8vo., 1*s*. 6*d*.

Dr. Ballard's Physical Diagnosis of Diseases of the Abdomen. 1 vol., small 8vo., 7*s*. 6*d*.

Dr. Ballard on Pain after Food, its Causes and Treatment. 1 vol., small 8vo., 4*s*. 6*d*.

*Dr. Garrod's Essentials of Materia Medica, Thera-*peutics, and the Pharmacopœias. Fcap. 8vo., 6*s*. 6*d*.

Mohr and Redwood's Practical Pharmacy. 400 Woodcuts. 8vo., 6*s*. 6*d*. cloth.

Liebig's Handbook of Organic Analysis. By Dr. Hoffmann. 85 Illustrations. Small 8vo., 5*s*.

Wohler's Handbook of Inorganic Analysis. By Dr. Hoffmann. Small 8vo., 6*s*. 6*d*. cloth.

Liebig's Familiar Letters on Chemistry. Fcap. 8vo., 6*s*.

Liebig's Principles of Agricultural Chemistry; with Special Reference to the Late Researches made in England Small 8vo., 3*s*. 6*d*. cloth.

Liebig's Agricultural Chemistry. Fourth Edition, revised. 8vo., 6*s*. 6*d*. cloth.

Liebig's Animal Chemistry; or, Chemistry in its Applications to Physiology and Pathology. Third Edition. 8vo. Part I. (the first half of the work) 6*s*. 6*d*. cloth.

Parnell's Elements of Chemical Analysis. Second Edition, 8vo., 9*s*.

Parnell on Dyeing and Calico Printing.

(*Reprinted from* PARNELL'S "APPLIED CHEMISTRY IN MANUFACTURES, ARTS AND DOMESTIC ECONOMY, 1844.") With Illustrations. 8vo., 7*s.* cloth.

Dr. Lardner's Handbook of Natural Philosophy,

with 1334 Illustrations. Complete in 4 vols., 12mo., 20*s.*

*** Each Volume is complete in itself, and is sold separately as under:—

MECHANICS	One Volume.	5*s.*
HYDROSTATICS, PNEUMATICS and HEAT	One Volume.	5*s.*
OPTICS	One Volume.	5*s.*
ELECTRICITY, MAGNETISM, and ACOUSTICS	One Volume.	5*s.*

Dr. Lardner's Handbook of Astronomy.

A Companion Work to the "HANDBOOK OF NATURAL PHILOSOPHY." 2 vols., 5*s.* each.

The Microscope.

By DIONYSIUS LARDNER, D.C.L. (From the "Museum of Science and Art.") One vol., with 147 Engravings, 2*s.* cloth lettered.

Reichenbach's Researches on Magnetism, Electricity,

Heat, Light, Crystallisation, and Chemical Attraction in their relation to the Vital Force. Translated and Edited (at the express desire of the Author) by DR. GREGORY. One vol., 8vo., cloth, 6*s.* 6*d.*

The Electric Telegraph Popularised.

By DR. LARDNER. (From the "Museum of Science and Art.") 100 Illustrations, 1 vol., 2*s.* cloth.

Dr. Parkes on Self Training by the Medical

Student. The Introductory Lecture delivered in University College at the commencement of the Medical Session, 1856—1857. Fcap. 8vo., 1*s.*

LONDON:
WALTON AND MABERLY,
28. UPPER GOWER STREET, AND 27. IVY LANE, PATERNOSTER ROW.